9.—NOTES ON ENTOZOA OF MARINE FISHES OF NEW ENGLAND, WITH DESCRIPTIONS OF SEVERAL NEW SPECIES.

PART II.

By Edwin Linton.

The following paper contains notes on forty-two species of Cestod worms, eight of which were described in my former paper.*

After having had access to new material for study, with some added experience in the study of these difficult and often perplexing forms, I have been brought to somewhat different conclusions from those arrived at in my first paper. The changes in the nomenclature of the first paper are in brief as follows:

(1) *Phyllobothrium thysanocephalum* is referred to a new genus, and is recorded in this paper by the name *Thysanocephalum crispum* Lt.

(2) The species recorded as *Rhynchobothrium tenuicolle* Rudolphi I now regard as a different species. It is referred to a new species in this paper, and bears the name *Rhynchobothrium bulbifer*.

(3) *Rhynchobothrium bisulcatum* of my first paper was referred to the wrong genus. It is recorded in this paper as *Tetrarhynchus bisulcatum*. The reasons for the above changes will be found among the observations on the species.

Genera with regard to which there is some doubt are *Spongiobothrium*, *Anthocephalum*, *Orgymatobothrium*, and *Crossobothrium*.

There are peculiar difficulties in the way of classifying the unarmed *Tetrabothriidæ* and more investigation is needed in order to arrive at the truth. Further investigation upon fresh material may render it possible, as it is certainly desirable, to unite several genera of the *Tetrabothriidæ*.

It is with much reluctance that I have found myself obliged to add several new generic names, some of which, after further study of new material, may have to be relegated to the already spacious limbo of synonyms in this order. I find, however, that the descriptions which

* Notes on Entozoa of Marine Fishes of New England, with descriptions of several new species. Report of U. S. Fish Commissioner for 1886. Pp. 453–510. Plates I–VI.

have been most useful to me in the work of identification, are those which give many details of structure and are accompanied with illustrations. Whether the name given by the describer holds or not is a matter of secondary importance.

I have restored Van Beneden's genus *Acanthobothrium*, which had been combined with the genus *Calliobothrium* by Diesing. This necessitates an emendation of the definition of the latter genus. I have separated from the genus *Echeneibothrium* those species with echeneiform bothria, which are destitute of a myzorhynchus, and placed them in the new genus *Rhinebothrium*. Three genera, in which the bothria are united into a globe or disc were discovered, whose systematic relations are open to some debate. These have been named *Lecanicephalum*, *Tylocephalum*, and *Discocephalum*, respectively. The family name *Gamobothriidæ* is suggested for these forms, although I have thought best to put them provisionally with the *Tetrabothriidæ*. The species which I have described under the name *Paratænia medusia* has caused me much perplexity, to determine its relationship.

The specimens which are described in this paper were collected, for the most part, during the months of July and August 1886–'87, at Wood's Holl, Massachusetts. During the summer of 1887 I made most careful and painstaking search for small forms, and was eminently successful in my examination of the sting ray (*Trygon centrura*) and dusky shark (*Carcharias obscurus*). During these researches a variety of encysted forms were obtained. These were most abundant in the *Teleostei*. Several species of Trematods, Nematods, and Acanthocephala have been found. Descriptions of these will appear in due time. I have learned by experience that brief descriptions of these soft-bodied and variable forms are of but little use in identification, and have therefore endeavored to give such descriptions as will enable future investigators to identify the species accurately. It has been found that measurements, even of parts that are liable to great alteration on account of contraction, are invaluable as a means of identification. Measurements of hard parts, such as hooks, spines, and, to a certain extent, ova, are of course of the highest importance. Too much weight, however, should not be attached to absolute values where the differences are slight. Different methods of obtaining measurements, inaccuracies in computation, and individual errors must be allowed for. On the other hand, much weight must usually be given to relative dimensions, since in that case, several of the above-named sources of error are eliminated.

As far as it was possible to do so the specimens were studied while they were alive. Sketches of living forms were made by my wife while I was engaged in collecting, assorting, measuring, and recording observations on the specimens. I was thus enabled to collect much more data in the short time at my disposal than would have been possible without this assistance.

It may not be amiss to give here, for the benefit of collectors, the plan

which I adopted to keep track of my material and the notes and sketches made at the time of collecting. Since it was not desirable usually to attempt to identify the specimens in the short time during which they could be studied alive, especially, as was often the case, when my table was covered with a dozen or more dishes each containing a lot of specimens to be assorted, I found it convenient to keep what I may call a numerical check-list. In this check-list each capture is denoted by a number, while the different species or groups into which the lot was assorted are indicated by the letters of the alphabet. The check-list contains the date of capture, number of fish examined, and usually the number of specimens obtained. A few numbers quoted from the check-list itself will illustrate the method sufficiently.

190, August 6 (1887), Trematods, same as No. 179*b*, gills and stomach of *Echeneis remora;* stomach empty.

191*a*, August 6, Long red Nematods (viviparous), same as 184*a*, on viscera and under peritoneum of *Lobotes surinamensis.*

191*b*, Cysts and embryo *Rhynchobothria* from viscera, under peritoneum of same.

191*c*, Trematods, intestine of same, fifteen specimens, small.

191*d*, Two small Nematods, intestine of same.

192*a*, August 8, Rhynchobothria from stomach of *Trygon centrura;* one ray examined.

192*b*, *Phyllobothrium*, one specimen, from lower part of spiral intestine of same, same as No. 178*b*.

192*c*, *Acanthobothrium*, numerous, spiral intestine of same.

Labels with numbers and corresponding data from check-list were placed in the bottles or vials in which the specimens were preserved. When greatly pressed for time temporary labels with numbers only were placed with the specimens. These were replaced as soon as possible by labels containing all necessary data. In cases where the living specimens were studied notes were kept on small pieces of paper of uniform size. A small tablet of unruled paper $5\frac{3}{4}$ by $3\frac{3}{4}$ inches was found convenient for this purpose. Where several pages of notes were filled from the study of a single number, the pages were not only numbered, but each page was marked with the check-list number. The pages were then pinned together and placed in a large envelope, where they were kept in numerical order so that they could be referred to without delay. Sketches of living forms were made, sometimes with the notes, but usually on separate pieces of paper. A tablet of unruled writing paper, 9 by $5\frac{3}{4}$ inches, was found to be a convenient size for sketches. Every sketch was marked with the check-list number. The sketches were kept in a separate envelope, and arranged in numerical order.

With the specimens, notes, and sketches numbered and arranged according to a uniform system, it was scarcely possible for any mistake to occur in the way of referring a specimen to other than its proper host. It was also easy to collect duplicates into a group for study. In the winter months, whenever a half-day, or even less, was at my disposal it was possible to utilize the time in a way that could scarcely have been done if no special method of work had been pursued. As far as time and material would permit, specimens were prepared by stain-

ing and sectioning for anatomo-histological study. In final writing all notes were revised and their data incorporated in the description for publication.

I have not attempted to give complete synonymies, but have in each case given what seem to me to be the more important references. The older synonymy can be found in Diesing's classical work.

Under the formal heading "habitat," I have given only the host in which I have found the species. For new species this is complete, but it is, of course, incomplete for old species. In the latter cases I have alluded to the usual host or hosts in connection with remarks on the species.

So far as my investigations go, it would appear that very few of the cestod entozoa of fish pass their adult stage in different specific hosts. With regard to the encysted forms, however, the range of hosts appears to be greater.

The nomenclature of fishes used in this paper is that adopted by Prof. G. Brown Goode, in "The Fisheries and Fishery Industries of the United States, Section I, Washington, 1884." I desire to express here my sincere obligations to Mr. Vinal N. Edwards for his valuable assistance in providing material for study. It is but a poor acknowledgment of the valuable services rendered by my wife, Margaret B. Linton, in the preparation of this paper, to say that the illustrations which accompany it are the work of her hand.

Order CESTOIDEA.

Family I—PSEUDOPHYLLIDÆ *Van Beneden.*

Dibothriidæ Diesing.

Dibothrium Rudolphi.

Usage is about equally divided between the names *Dibothrium* and *Bothriocephalus* for this genus. Rudolphi used the name *Bothriocephalus* as a generic title, and divided the genus into two subgenera to which he gave the names *Tetrabothrium* and *Dibothrium.* The latter, as used by Rudolphi, had about the same limitations as it now has.

1. *Dibothrium restiforme*, sp. nov.

[*Restis*, a cord.]

[Plate I, Figs. 1–16.]

I have found it necessary to make a new specific name to accommodate four *Dibothria* from the intestine of the rare silver gar (*Tylosurus caribbæus*).

The head of the living worm is broad-oval, flat, two-lobed, the lobes longitudinally and somewhat radiately striated, rather squarish or

shouldered behind, and tapering to a blunt point in front. Two very deep fossæ which are marginal with respect to the head, lateral with reference to the body, divide the head into two leaf-like lobes, with thin flexible borders. When the edges of the lobes are closely appressed the fossæ appear as marginal slits. The fossæ extend to the apex of the head but do not unite. Each fossa is continuous behind the head with a narrow median furrow.

The body near the head is quite narrow, almost cylindrical, or a little flattened on the margin to correspond with the greater marginal diameter of the head. It is very much narrower than the head. The segments begin immediately behind the head, where they are short and thick and very much crowded. They increase in length slowly until about the posterior third where they are nearly square. The segments of the posterior third are nearly square and quite thin. The body is of nearly uniform breadth throughout its entire length.

Genital apertures lateral near middle of segment, male and female approximate. Aperture of oviduct on opposite lateral face of strobile near anterior edge.

Maximum length 765^{mm}; breadth of body 1.8^{mm}; breadth of head 2.5^{mm}.

Habitat.—Tylosurus caribbæus, intestine. Buzzard's Bay, Massachusetts, July 27, 1886. Four specimens.

Three of the specimens were very slender, almost filiform, the other was more contracted and consequently thicker, but it, too, was of nearly uniform size throughout.

The shortest specimen measured about 64^{mm} in length when lying undisturbed in water. When taken by the posterior end and lifted slowly from the water, allowing it to stretch out to its fullest extent by its own weight, it increased in length to 240^{mm}. The largest specimen, measured in the latter way, was 665^{mm} in length. After lying in sea-water for twenty-four hours it was again measured and found to be 765^{mm} in length. After being preserved twelve months in alcohol it still measures 720^{mm} in length. The other specimens while living measured 215 and 262^{mm} respectively.

The genital apertures are lateral; on the larger specimen the following points were made out with no other aid than a simple lens: On one of the lateral faces openings occur on the middle of the segments along the median line. These apertures were traced to within 160^{mm} of the head, where they merged into a median lateral groove; the latter is continuous with one of the marginal fossæ of the head; on the opposite lateral face there is a small opening or pore near the anterior edge of each segment; these pores are not usually exactly on the median line of the strobile, but stand a little to one side or the other and thus make an irregularly sinuous line; they were traced to within 240^{mm} of the head, where they become indistinguishable in the median groove; the latter, like its fellow on the opposite face, extends to the head, where it is continuous with the other marginal fossa of the head.

There is danger of some confusion in the use of the terms marginal and lateral in the description of this worm, arising from the fact that what one naturally calls the margin of the head is continuous with the lateral face of the body; in a brief description of the worm, therefore, one should say bothria lateral, if by bothria the deep fossæ are meant.

The posterior segments are slightly irregular; in one case two segments were fused into one and the last segment was somewhat distorted.

The following measurements were taken from the longest specimen after it had lain for some time in alcohol. Length of strobile 720^{mm}; length of head 4^{mm}; breadth of head at base 2^{mm}, middle 2.5^{mm}, apex 1^{mm}; thickness of head 1.5^{mm}; diameter of neck 1^{mm}. The diameter of the neck, or, more properly speaking, of the body immediately behind the head, is a trifle greater when measured in a line corresponding to the breadth of the head than it is on a line corresponding to the thickness of the head.

In the alcoholic specimens the shape of the body differs very little from that of the living worm. It still has the same uniformity of breadth throughout. There are, however, some differences in the head which are worthy of mention. The head of the alcoholic specimen is shorter, thicker, and more bluntly pointed than that of the living specimen. The apex of the head is almost truncate. The lips of the fossæ are more or less crimped and folded and the fossæ are somewhat gaping, while the broad lobes are deeply furrowed. These furrows are, in the main, longitudinal.

The median lateral furrows of the body are, in the alcoholic specimens, very strongly marked. Near the head each median furrow appears to turn to one side in order to meet the fossa of the head, in which it terminates. The true nature of this apparent twist in the anterior part of the body is made evident by transverse sections of the head and anterior segments as described further on. While in the living worm the anterior segments are very indistinct, in the alcoholic specimens they are tolerably distinct and can be traced almost to the head. Near the head they are about .17^{mm} in length and 1^{mm} in breadth. At a distance of 15^{mm} from the head the length is .22^{mm}; breadth 1.2^{mm}; thickness .84^{mm}. Two hundred millimeters back of the head the segments are .36^{mm} long, 1.8^{mm} broad and .8^{mm} thick. At a distance of 330^{mm} from the head the segments are .8^{mm} long, 1.8^{mm} broad and 6^{mm} thick. Near the posterior end of the longest specimen, the length of the segment is 1.9^{mm}, breadth 1.4^{mm}, thickness .5^{mm}.

After staining with carmine, transverse sections of the head were made in order to ascertain, if possible, the nature of the fossæ as compared with the cupping disks of such a species as *D. microcephalum*. The sections at the apex of the head prove the fossæ to be true bothria, Fig. 9. In these sections there is a nearly square central part measuring .22 and .3^{mm} in its two diameters, with the crescent-shaped sections of the apices of the bothria lying at the two longer sides. In the

first half-dozen sections the bothria are distinct from the central part, of which they appear to be small auriculate appendages. The position of the bothria at this point is very plainly lateral. The bothria soon become fused with the central part and then lose their distinctive character, appearing simply as deep indentures on the sides of the head. Fig. 10. The diameter of the central core of the head, at the point where the bothria cease to be distinct, measured between the bottoms of the pits, is .26^{mm}. The diameter through the head at right angles to this is .49^{mm}. The breadth of the sections, including the edges of the bothria is .6^{mm}. The latter edges are induplicate, if straightened the breadth would be increased .2^{mm}. Proceeding towards the base of the head the sections are found to differ gradually the one from the other. The distance between the bottoms of the fossæ becomes shorter and shorter, until, at the point where the lobes of the head are widest, the pits are separated from each other by a mere thread .06 to .08^{mm} diameter, Fig. 13. The diameter of the head at right angles to the above, that is, in the direction which answers to the thickness of the head, is .74^{mm}. The diameter in the latter direction has increased from the apex to this point from .49^{mm} to .74^{mm}, while the opposite diameter, that is, the distance through the head from the bottom of one pit to the bottom of the other, has decreased, in the same distance, from .26^{mm} to .06^{mm}. The edges of the fossæ have, in the mean time, increased in length. In fact they no longer appear as lips of bothria, but rather as prolongations of borders of a bi-lobed head. The inner faces of these prolongations are smooth, as shown by the entire outline of the cross-section, while the outline of the outer faces is deeply crenulate on account of the longitudinal furrows there cut through. The thickness of these prolongations at base is about .32^{mm}; at the apex, that is, at the margin of a lip of the bothria, about .08^{mm}. The entire breadth of the head at this point, about the widest part, is, when the lobes are straight, in the neighborhood of 2.6^{mm}. Transverse sections, for the greater part of the length of the head, bear a close resemblance to the figure eight.

Towards the base of the head the central part widens quite rapidly. At first this widening is, for the most part, at the expense of the fossæ. For example, in a section where the greatest breadth of the head is 2^{mm}, the distance between the bottoms of the fossæ is .68^{mm}. A little further back the fossæ are represented by deep grooves, while the sections are nearly trapezoidal with crenulate outlines.

In the mean time the aquiferous vessels have made their appearance. A line joining the two main vessels, as seen in section, would be very nearly at right angles to a line joining the deep grooves, which represent the continuation of the fossæ. The sections were carried back of the head a short distance. In the last ones made, the deep emarginations at the ends of the section show the position of what further back on the body are the lateral grooves. The aquiferous vessels still occupy the same relative position with reference to these emarginations.

Since the aquiferous vessels occupy the same relative position with reference to the fossæ of the head as the grooves on the anterior part of the body, and, as is shown by sections of mature segments, with reference also to the lateral rows of pores and genital apertures, the fossæ are proved to be lateral. The apparent shifting of the grooves from the margins of the head to the lateral sides of the body already alluded to is, therefore, due to a simple twisting of the body behind the head. This twisting is a natural result of the flattening of the head in a plane which is at right angles to the plane of flattening of the body.

A longitudinal section through the head shows that the central part resembles the entire head of such species as *D. manubriforme* and *D. punctatum*, which have rather long and slender heads. The thin edges of the lobes of the head of this species, as indeed is plainly shown by sections near the apex of the head, are simply the prolonged lips of normal bothria.

With regard to the musculature, the longitudinal fibers are pretty uniformly distributed through the head—a little more abundant near the borders and at the center. No definite arrangement into fascicles was observed in the head. The transverse fibers are very fine and abundant, and cross each other in the most intricate fashion. Towards the base of the head the longitudinal muscle fibers predominate in the center. Behind the head they are arranged in fascicles. In longitudinal sections made a short distance back of the head these fascicles were beautifully shown. They appeared as rather large isolated bundles of slightly wavy longitudinal fibers.

The vessels of the water vascular system appear to branch irregularly through the lobes of the head, and are not collected into the principal channels until toward the base of the head. Immediately behind the head the cut ends of the two principal vessels are seen in section as narrow oblique apertures, .016 and .008^{mm} in the two diameters.

In respect to the disposition of the reproductive organs the results of my investigations thus far are not wholly satisfactory. The reproductive openings proper are situated along the median line of one of the lateral faces of the body and are about the middle of the length of the segment. The single large aperture, which, with its slightly raised border, can be seen easily with an ordinary lens, is the common opening for both the sexual organs of the segment. After two or three thin longitudinal sections have been made on the side of the segment which bears the reproductive opening, the vagina is brought into view lying immediately behind the opening of the cirrus and close to it. The male aperture quickly widens into the cirrus pouch, .08 to .1^{mm} in diameter, as the sections are carried towards the interior of the segment. The vagina remains of uniform size, about .016 to .021^{mm} in diameter. The cirrus pouch in transverse sections is oval. It extends to the middle of the interior of the segment, that is, the pouch is equal in length to about half the thickness of the segment. The cirrus was invaginated

in all cases, but was plainly seen as an irregularly convoluted tube lying within the pouch. The vagina follows the posterior edge of the latter as far as its base. I have not yet been able to determine its course beyond that point with any degree of certainty.

The interior of the unripe segments, when seen either in cross or longitudinal sections, appears for the greater part to be an open net-work of connective fibers, in the spaces of which are granular bodies, of which three different sets were made out. What I take to be the ovary is a lobed body, lying near the posterior edge of the segments, and symmetrically on each side of the median line. It lies nearest that lateral face which does not bear the sexual apertures. It is broader in its transverse than in its longitudinal diameter. In its widest part it equals about one-fourth the breadth of the segment, and in its thickest part it about equals one-fourth the thickness of the segment. Immediately above it a small oval body was observed in some of the transverse sections, which I take to be the shell-gland. In front of the ovary and occupying the middle of the interior of the segment there is a mass of granular globular bodies which are differentiated into two kinds by carmine. The more central ones remain yellowish in color while the others are deeply stained. The latter I take to be the testes, the former is probably the vas deferens.

The walls of the cirrus-bulb and of the vaginal tube are clearly defined and composed for the most part of circular fibers.

Near the anterior edge of each segment, and on the side opposite that which bears the reproductive apertures, is situated a circular aperture about .04^{mm} in diameter. It enlarges into an inner cavity which apparently communicates with some large irregular spaces that probably represent sections of the uterus. The wall of this aperture, as well as those of the inner cavity, with which it communicates, are rather thick and granular. On the mature segments these apertures persist and become larger, while those of the reproductive organs become rather indistinct. In the mature segments they were also seen to communicate with enlarged open spaces which, in the younger segments, contain granular masses. The mature segments are, to a great extent, filled with the ample folds of the uterus, which are crowded with ova. The uterus, and the ovary together in these segments, have the appearance of the letter S.

In the posterior part of the segment those folds of the uterus which are adjacent to the ovary are crowded together so as to form an irregularly lobed mass. In the middle of the segment the lobes are parallel with each other in a direction transverse to the axis of the segment, and, for the most part, one side of the median line. In front of this the uterus broadens and loses its lobed appearance, while the contained ova are not so densely crowded. This part of the uterus corresponds to the open cellular spaces observed in the sections. It is to be noticed that this part of the uterus, which lies in the anterior part of the seg-

ment, contains the mature ova, and is, furthermore, in the vicinity of the excretory pore, from which the ova evidently make their escape.

Upon examining a section through one of these mature segments, the ova are discovered to be yellowish, opaque, quite irregular in outline, without hard shells, or rather appearing as if the shells were soft and yielding and had collapsed. While there is much variety in the shape and size of these ova, the prevailing shape is oval and the dimensions about .033 and .018^{mm} in the two diameters.

None of the specimens in this lot were, strictly speaking, mature. At least the ova did not appear to be mature, and the folds of the uterus contained, in addition to veritable ova, slightly larger spherical or suboval masses. The latter, in specimens stained with carmine, consisted of a clear, pellucid, structureless membrane containing a granular mass, which was frequently deeply stained. There was no tendency whatever for the segments to become detached from each other.

2. *Dibothrium manubriforme* Lt.

[Report of Commissioner of Fish and Fisheries for 1886, Plate I, Figs. 1–4.]

In August, 1886, I had the opportunity of examining a sail-fish (*Histiophorus gladius*) taken off Newport, Rhode Island. I found but a single intestinal parasite, a *Dibothrium*, which I recognized at once, in spite of its mutilated condition, to be very near, if not identical with, my *D. manubriforme*, which was obtained the previous summer from a spearfish (*Tetrapterus albidus*).

The head of the worm could not be found and the entire specimen was in bad condition, owing to the fact that decomposition had set in in the viscera of its host. The specimen was tranferred to alcohol, and the measurements which are given are therefore all from the alcoholic specimen. It is very considerably longer than the specimens obtained from *T. albidus*, but a careful comparison with those specimens convinces me that it is identical with *D. manubriforme*.

In order to obtain a more certain identification of this specimen, I made transverse and longitudinal sections of some of the median segments and compared them with corresponding sections made from one of the specimens from *T. albidus*. This investigation confirmed me in my view that the specimen in question should be referred to *D. manubriforme*, and also enabled me to add some additional data to the anatomy of that species.

The specimen from *H. gladius* affords the following measurements: Length, 220^{mm}; breadth in front about 1^{mm}; greatest breadth 5^{mm}, at a point 70^{mm} from the posterior end; breadth at posterior end 2^{mm}, where it terminates in a bluntly rounded point. The body is about 1.5^{mm} thick at the thickest point. The worm is therefore rather slender, but this habit might be very much changed by contraction. The difference in length between this specimen and those from *T. albidus*, the

longest of which measured 140^{mm}, becomes less significant when it is remembered that the former when found was practically dead and consequently there was little or no contraction of its tissues when it was transferred to water and to alcohol. The tissues of the other specimens were living and were therefore liable to contract when placed in water after removal from their host, or when first disturbed in their resting place.

The posterior third of the body of the specimen from *H. gladius*, as in those from *T. albidus*, is marked by a dark brown median stripe made by the ripe ova in the crowded ovaries. A median furrow on one of the lateral faces of the body begins towards the anterior and becomes punctate towards the posterior region, where the minute lateral genital apertures become visible in a zig-zag row. The margins of the strobile are apparently entire. The segments are very short, with their posterior edges slightly wavy on the median segments, thus suggesting those of *D. plicatum*. The posterior edges of the median segments are crowded together like the edges of the leaves of a book about .2^{mm} apart. Near the posterior end they are not so closely crowded, being about .4^{mm} apart. The anterior part had undergone decomposition to such an extent that it was reduced to a mere filamentary shred which gave no sign of the presence of either bothria or segments.

The ova in this specimen are identical with those in the other lot. They present also the same features noted in the case of the others; that is there seem to be two sorts, one yellowish in mounted specimens, with a strong shell, in some cases white and opaque; another sort transparent, with a very thin shell. The latter, in specimens stained with carmine, have a granular contents which is colored by the staining fluid. They are entire in outline, oval, length as much as .05^{mm}, shorter diameter .03^{mm}. These measurements were obtained from both lots. Transparent yellowish ova were found which were usually collapsed on one side, thus being bowl-shaped. They measured .054^{mm} and .027^{mm} in their two diameters. The diameters of ova given in my original description of this species are .045^{mm} and .03^{mm}. These dimensions may be taken as average.

Anatomy.—Transverse sections, made through that part of the body which is immediately in front of the segments that contain ripe ova, show that the body is made up of a series of concentric layers of muscular tissue surrounding a flat core. Next to the thin cuticle is a thick granular layer in which lie radiating, longitudinal, and circular fibers. Of these the circular fibers are the finest. They appear, indeed, as delicate hair-like lines under an enlargement of 600 diameters.

The granules in the outer layer in longitudinal sections, stained with carmine, in many places appear as clusters or nests of nuclei. Towards the posterior end of each segment the circular fibers become more numerous about the middle of the outer concentric layer, and presently the

layer is differentiated into two distinct layers. The outer of these layers is finely granular, and contains very few longitudinal fibers. In it the radiating and circular fibers predominate. The inner layer, on the other hand, is coarsely granular, and contains a considerable number of longitudinal fibers. The outer of these two layers soon separates from the other along the line of fine circular fibers to form the projecting posterior edge of the segment. Next within the granulo-muscular layer is a thin layer of circular fibers, and within this again a thick layer of longitudinal fibers. The latter are very large, although not at this point in distinct fasciculi. Farther back towards the posterior end they become fascicled. The connective tissue in this layer appears finely granular in transverse sections, while in longitudinal sections it appears as a network of delicate fibers which fills up all the interstices between the longitudinal fibers. The longitudinal fibers of the inner part of the granular layer do not differ essentially from those of the longitudinal muscle layer proper, except that they are more scattered, while their interstices are filled with connective tissue in which are numbers of both coarse and fine granules, highly colored in carmine-stained sections. The longitudinal muscular fibers in general do not lie parallel with each other. They form, indeed, a maze of interlacing and apparently anastomosing fibers whose general direction is longitudinal. The diameter of the largest single longitudinal fibers in the granular layer is about .004^{mm}, and, in the longitudinal muscle layer proper, twice as much. The longitudinal muscle layer is separated from the inner core of the segment by a thin layer of circular fibers. It is, moreover, interrupted at the margins where it is penetrated by the margins of the inner core. The latter is fusiform in transverse section, and contains the reproductive organs. It is crossed by numerous fine transverse connective fibers, and extends nearly to the margins of the segment, where it appears to be continuous with the inner granular layer. It is quite narrow except in ripe segments, where the center becomes very much enlarged on account of the presence of the numerous ova. The central mass of ova enlarges at the expense of the longitudinal muscle layer. The walls of the segment are also bulged outward by the mass of ova.

The reproductive apertures are near the median line on one of the lateral sides. They are very close together and rather small. Each aperture represents a pair of sexual organs, cirrus and vagina. Upon making a few longitudinal sections on the lateral face which bears the reproductive apertures, the small vaginal opening comes into view. It opens into the common aperture from behind and near the surface. The larger aperture continues into the cirrus-bulb, which has thick muscular walls composed of circular fibers. The cirrus was retracted in all cases. It is about .008^{mm} in diameter. The bulb is rather long and descends into the segment vertically nearly to the middle. The relative position of the various organs was not ascertained with entire satisfaction. The vagina, however, lies close to the posterior side of the

cirrus-bulb and communicates with the ovary. The latter organ is centrally placed and lies next the inner side of the lateral muscular wall on the side opposite the genital aperture.

The testes are represented by granular masses in the marginal parts of the inner core.

The following measurements will assist to an understanding of the proportions and arrangements of the various muscular layers of the body: thickness of inner core at center .16^{mm}; near margin .08^{mm}; thickness of longitudinal muscle layer .2^{mm}; thickness of inner granular layer .12^{mm}; thickness of outer granular layer .16^{mm}. The layers of circular fibers are very thin, averaging about .01^{mm} in thickness. Breadth of inner core, margin to margin, 3.6^{mm}; breadth of segment 4^{mm}.

Longitudinal sections were carried through several contiguous segments. In these there were no septa to indicate a division of the body into true segments. The only indication of a segmented condition is the superficial character of projecting posterior edges. The longitudinal muscles are continuous and the ovaries are crowded together so as to form an almost unbroken zig-zag line. So far as any internal characters go, the body is practically continuous.

The above observations were made on sections lightly stained with ammonia carmine. The sections used in the description are from one of the specimens from *Tetrapterus albidus*.

Habitat.—*Tetrapterus albidus*, intestine, young and adult, July, 1885; *Histiophorus gladius*, intestine, adult; August, 1886. Off Newport, Rhode Island.

3. *Dibothrium punctatum* Rudolphi.

[Plate II, Figs. 1–4.]

Bothriocephalus punctatus Rudolphi, Entozoa Hist., III, 50, and Synopsis, 138 and 475. Leuckart, Zool. Bruchst., 40 and 64, Pl. I, 40. Drummond, Charlesworth's Mag. of Nat. Hist., II, 574. Eschricht, Isis 1839, 344, and in Nov. Act. Nat. Cur. I, XX, Suppl. II, 77 and 59, Pl. III, 17–18. Dujardin, Hist. Nat. des Helm., 617. Bellingham, Ann. Nat. Hist., XIV, 254. Van Beneden, Bull. Acad. Belgique, XVI, II, 278, and in Mem. Acad. Belgique, XXV, 161, Pl. XXI. Spencer Cobbold, Trans. Linn. Soc., XXII, 157. Olsson, Lunds Univ. Arsskrift, IV, 11. Von Linstow, Compend. Helm., 237.

Dibothrium punctatum Rudolphi, Diesing, Syst. Helm., I, 593; Sitzungsb., XIII, 579; Revis. der Ceph. Ab. Par., 240. Leidy, Proceed. Acad. Phila., VII, 444, and VIII, 46. Molin, Denksch. d. kais. Akad, XIX, 235.

For additional bibliography, etc., see Diesing's Syst. Helm. and Revisions.

Diesing's description of this species is as follows: Head oblong, rather broad, with oblong lateral bothria. Neck none. First segments elongated, subsequent segments subquadrate. Genital apertures opposite on the lateral face of each segment. Length, 300 to 450^{mm}.

This species has been very fully described by Mueller, Rudolphi, and others. It is said to be an abundant species in various fishes of

Europe, *Cottus*, *Scorpius*, *Gadus*, *Pleuronectes*, *Trigla*, *Rhombus*, etc. Eleven species of European fish are enumerated by Diesing as harboring this parasite. It has been recorded in this country by Dr. Leidy in *Platessa plana* (*Pseudopleuronectes americanus*).

I refer to this species two lots of Dibothria obtained from the intestines of the spotted sand flounder (*Lophopsetta maculata*) and the sand dab (*Limanda ferruginea*). The first lot containing one complete specimen and a few fragments of others, with a few cestoid cysts from the peritoneum, was the sole result of an examination of seven flounders. In the second lot about a dozen fish were examined, nearly all of which were infested with an echinorhynchus (*E. acus*). These fish were taken with the trawl by the U. S. Fish Commission steamer *Fish Hawk*, south of Martha's Vineyard, Massachusetts, in about 12 fathoms of water. Their stomachs contained several species of Annelids, fragments of *Squilla*, and several specimens of a species of *Margarita*.

The sketches of the living worm (Figs. 1 and 2) were made from the specimen obtained from *L. maculata*. Its dimensions while living were as follows:

	Millimeters.
Length	200.00
Length of head	2.40
Breadth of head at apex	0.24
Breadth of head, middle	0.42
Breadth of head, base	0.22
Breadth of first segment at anterior margin	0.20
Breadth of first segment at posterior margin	0.24
Length of first segment	0.36
Breadth of one of posterior segments	2.60
Length of same	1.20

Associated with this specimen, and doubtless belonging to it, was a chain of mature segments, each of which was about 2.1^{mm} in length and 1^{mm} in breadth.

The head of the living worm showed little tendency to change its shape. It maintained constantly the proportions shown in Figs. 1, 2.

It is rather flat, broadest in the middle, and tapers uniformly with convex margins toward each end. It is terminated in front by a slightly tumid apex. The base of the head continues in a short neck-like part, which has a projecting border on the posterior edge like that of the segments. The marginal pits are quite deep. In front they extend to the tumid apicular part. They terminate behind at about the posterior fourth or fifth of the entire length of the head, leaving a short, constricted neck-like part.

The only motion observed was a slow change in the edges of the bothria, which at times were nearly parallel and at others were profoundly crenulated. In active specimens they are evidently capable of assuming very various shapes.

After having been preserved in alcohol the head is of nearly uniform breadth throughout. It is slender and arcuate, measuring 1.8^{mm} in

length, and 0.16^{mm} in breadth at the apex, increasing to 0.2^{mm} in the widest part. The length of the first segment is 0.28^{mm}, its breadth in front 0.11^{mm}, behind 0.15^{mm}. The anterior segments for about 16^{mm} back of the head are quite slender. The body, indeed, for this distance is decidedly filiform, and for that reason it is very difficult to determine whether the bothria are to be regarded as marginal or lateral with reference to the body. Secondary segments appear at about the twelfth segment from the head. These are formed by a division of each segment into two by means of a median transverse line. This is repeated farther back in much the same manner as described under *D. microcephalum*. This evidently explains the phenomenon which the posterior segments present of being welded together in groups of three or four, an appearance which is quite characteristic of the posterior segments and which has been alluded to in various descriptions of this species. The posterior segments are squarish, with the posterior edge of each slightly overlapping the following segments, and thus giving to the strobile a serrate margin.

About 40^{mm} from the head the reproductive organs become visible. In a specimen rendered partially transparent with glycerine they appear as a median row of white opaque masses 0.2^{mm} long and 0.06^{mm} broad, lying transverse to the longitudinal axis of the worm, parallel to each other and very close together. The apertures of the reproductive organs are lateral, all on one side, and may be seen following the median line as a row of small elevated papillæ. In the middle of the strobile there sometimes appear to be as many as four or more papillæ to a single segment. These compound or fused segments probably divide into simple segments as they mature. Toward the posterior end of the strobile, along with and on the reproductive papillæ, are clusters of ova which have been extruded from the ripe segments. The ova are yellowish-brown in color. On this account the median segments have a median band, which is equal in breadth to about one-third the breadth of the segment, and which is rusty yellow, or yellowish-brown, or in alcohol almost black. On either side of this median band the segments are punctate with brownish spots. Upon the opposite lateral face of the strobile also small bunches of ova were seen, which had been extruded from minute pores in the vicinity of the median line.

The ova are rather large, elliptical or long oval in outline; length, 0.058^{mm}; shorter diameter, 0.027^{mm}.

The vessels of the water vascular system are quite distinct in a specimen which has been placed in glycerine.

The two specimens from *Limanda ferruginea* have, in alcohol, the following dimensions:

	No. 1.	No. 2.
	Mm.	*Mm.*
Length	98.00	75.00
Length of head	1.60	3.20
Breadth of head at apex	.40	.40
Breadth of head, middle	.50	.48
Breadth of head, base	.50	.60
Length of first segment	.18	.16
Breadth of first segment	.48	.50
Length of posterior segment	1.00	.80
Breadth of posterior segment	2.00	2.50
Greatest breadth of body	3.50	2.75

The appearance of these specimens, especially with respect to the head and anterior segments, is quite different from that of the specimen from *Lophopsetta maculata*. Moreover, the heads of these two specimens differ with respect to each other. I do not, however, recognize any difference, either in proportions or in special characteristics, that can not be explained as due to different states of contraction. The heads of these latter specimens are arcuate, a condition which is plainly the result of unequal lateral contraction of the longitudinal muscles; they are blunt at the apex with slightly tumid edges, as in the first specimen. The fossæ are plainly lateral. This feature was uncertain in the first specimen, but in these it is quite evident on account of the highly contracted and consequently flattened condition of the anterior segments.

Although the head of one of these specimens is twice the length of the other, there can be no doubt that the specimens are specifically the same. The shorter head is of nearly uniform size throughout, averaging about .5^{mm} in diameter. It is crossed by exceedingly fine transverse wrinkles, most abundant at the base. These are evidently the result of contraction. The longer head is more slender for the greater part of its length than the other, but thicker at the base. It is, as a whole, somewhat cuneiform in shape.

When these specimens were placed in glycerine, with a little acetic acid added, the central axis of the head was brought into view. This is seen to be abruptly constricted behind the capitate apex, swollen immediately behind the constriction and again at the base of the head, while in the middle of the head it is slender.

The fossæ, which are marginal with respect to the head but lateral with respect to the body, are profound, and extend in one nearly, in the other quite to the base of the head.

The segments begin immediately behind the head and are at first more than twice as broad as long. In this feature they are quite dif-

ferent from the first specimen. They differ also from most descriptions of this species. The segments in question have, however, every appearance of being much contracted. Fine transverse lines appear on the faces, while the margins are wrinkled; the segments themselves are quite thick and stout. A short distance back of the head the segments are alternately shorter and longer, as noted in the first specimen, while toward the posterior end of the body the adult segments are arranged in groups of from four to six simple segments, as if the latter were partially fused together, which is another characteristic of this species.

The ova have the same dimensions as in the first specimen, and are collected in oval or oblong masses. Here and there a mass occurs whose size far surpasses those of adjoining segments, and which causes the walls of the containing segment to bulge out into a prominent lateral lump. This feature was also observed in the first specimen.

The external openings of the oviducts are on one side in the shape of a row of lateral pores along the median line. The reproductive apertures are on the opposite side. Of these, but one, the male, could be certainly made out in the specimen when examined entire in glycerine. In nearly every case the cirrus was protruded. It is short, conical, and stands about the middle of the segment on the median line. It was difficult to get exact measurements of the length. The following dimensions, which were obtained by turning the strobile on edge and measuring the cirrus in outline, are nearly correct: Length, .1^{mm}; breadth at base, .04^{mm}; breadth at apex, .026^{mm}. When retracted it becomes a very short papillæ. Upon examining a few segments in glycerine, with an enlargement of some three hundred diameters, I noticed that there were two ducts leading to the common opening. One of these was continuous with the protruded cirrus. The other led to a point behind the cirrus and at its base. I am inclined to believe from this that both reproductive organs have a common cloacal opening about the middle of the segment and on the median line. If this is the correct view, the vagina is quite small and opens immediately behind the cirrus. This differs materially from Van Beneden's figures of this species.

I have had some hesitation with regard to referring these specimens to *D. punctatum*, principally on account of its small size.

Drummond, however, in his "Notices of Irish Entozoa" (Charlsworth's Mag. Vol. II, p. 574) speaks of this worm as follows:

> I have found it largest in the brett, exceeding even 3 feet in length and as many lines in breadth; in the *cottus* I have found it 2 lines broad, and from 12 to 18 inches long, but in the turbot, so far as my observation has yet gone, it is seldom more than a line broad, and varies in length from 8 to 18 inches.

Since the hosts in which my specimens were found are closely related to the turbot of the other side of the Atlantic, it is of interest to note that the size of these Dibothria corresponds, in the main, with that of those which Drummond has found in the turbot.

Habitat—Lophopsetta maculata, August 10, 1887, *Limanda ferruginea*, September 6, 1887, Wood's Holl, Massachusetts.

4. *Dibothrium microcephalum*, Rudolphi.

[Plate II, Figs. 5–18.]

Tænia tetraodontis molæ, Viborg, Ind. Mus. Vet. Hafn., 241; Rudolphi, Entoz. Hist. III, 213.

Bothriocephalus microcephalus, Rudolphi, Synops., 138 and 473; Drummond, Charlsworth's Mag. Nat. Hist., IV, 241; Dujardin, Hist. Nat. des Helm., 619; Bellingham, Ann. Nat. Hist., XIV, 253; Von Linstow, Compend., der Helm., 274; Olsson, Lund's Univ. Årssk., III, 55, and IV, 11; Van Beneden, Mem. Acad., Belgique, XXXVIII, 87.

Bothriocephalus sagittatus, Leuckart, Zool. Bruchst., 39, Pl. I, 15.

Dibothrium microcephalum, Rudolphi, Diesing Syst. Helm., I, 592; Sitzungsb., d. kais. Akad., XIII, 578; Revis. d. Ceph, par., 241; Wagener, Nov. Act. Nat. Cur., XXIV, Suppl. 16, 69, Pl, VII, 77; Van Beneden. Bull. Acad., Belgique XXII, II, 521.

Head, sagittate in marginal, oblong in lateral, view, with a rounded button-like apex. Bothria lateral oblong, neck none, anterior part of body slender subcylindrical, median and postero-median part broader and thicker, narrower towards posterior. Body cylindrical or subquadrate in front and rather thick throughout. First segments somewhat funnel-form, subsequently becoming very short and broad, posterior segments short and narrow, squarish or sometimes indistinct.

Genital apertures marginal. Length in alcoholic specimens as much as 660^{mm}, greatest breadth 7.5^{mm}.

A lot of Dibothria containing thirteen individuals from the intestine of a sunfish (*Mola rotunda*) was collected by the U. S. Fish Commission off Martha's Vineyard, Massachusetts, September 10, 1886, and sent to me after my return from the laboratory at Wood's Holl, Massachusetts. I have therefore not had the opportunity of studying these parasites while they were living. All the data for this description were derived from the study of alcoholic specimens.

I have experienced much difficulty in reconciling differences between my specimens and previous descriptions. While I have little doubt but that the specimens in question are specifically identical with those figured by Wagener and Leuckart, there remains yet much to be desired in the way of a detailed description of the animal.

Among the thirteen specimens, all of which were adult and approximately of the same size, there was one which differed from the others in having an extremely small head and smaller and narrower anterior segments. The head had but little more than half the linear dimensions of the others, while the anterior segments were longer by nearly a third, and less than half as wide. The bothria, moreover, extended but a little way back over the first segment, while in the others they over-lapped the first two segments. The general outline of the head remains in other respects much the same for the two varieties.

These differences can not be accounted for by supposing different states of contraction, although it is true that contraction can and does give rise to differences in shape as well as in size. In this case, however, the differences are so profound, and, what is of still greater importance, so abrupt, there being no gradation by intermediate forms, I have felt myself obliged to recognize it by establishing two varieties. The specimen with the smaller head and narrower anterior segments I shall denote as variety α, the other as variety β. One might indeed be justified in separating them yet further and calling them distinct species if the same sharp distinction is observed in other collections. In that case variety α should retain the name *D. microcephalum*, and variety β should be referred to Leuckart's *D. sagittatum*.

Both Leuckart and Rudolphi mention the occurrence of individuals, some of which had relatively large, others relatively small heads. In the specimens which these observers examined, however, this difference could be accounted for apparently by a difference in the age of the specimens. The younger and immature individuals had relatively larger heads and longer anterior segments than the more mature specimens possessed.

I have recorded a similar difference in a lot of Dibothria from the filefish (*Alutera schœpfii*) (U. S. Fish Commission Report, 1886, pp. 458, 459, Pl. I, Figs. 5–8). In that case both varieties were equally immature. In the present instance both varieties are equally mature.

While there is, therefore, almost sufficient grounds for establishing a new species, or rather for separating the present species into two and restoring Leuckart's species, which has been united with *D. microcephalum*, I shall for the present be content with referring both kinds to *D. microcephalum*, but shall distinguish the kinds as var. α and var. β, respectively. Wagener's figure, which is sketched from a young specimen and gives a lateral view of the head and first segments, bears a very close resemblance to var. α. Leuckart's figure also represents a lateral view of the head and anterior segments. It bears little resemblance to either variety, but resembles var. β more than it does var. α. In it the head is represented as being bluntly rounded in front, while in all the specimens in the lot upon which this account is based there is a constriction near the anterior end which produces a blunt button-like apex. The head in lateral view is therefore oblong and not sagittate, as in Leuckart's figure.

The terms marginal and lateral as applied to the head in this description designate those sides which correspond to the marginal and lateral sides of the body, respectively, although this use of the terms gives rise to the anomaly that the marginal diameter of the head is greater than the lateral.

A comparison of Fig. 6 with Fig. 9 might lead one to infer that there is a great difference between the two varieties with respect to the appearance of segments at the posterior end. While this is true in many

cases it does not represent a necessary condition of things. Some of the individuals of var. β showed the same indistinctness with regard to the occurrence of segments at the posterior end as is shown in Fig. 6 of var. α. Indeed, as will be shown further on, the segmentation in this worm is more apparent than real.

In the following detailed description I have not attempted to keep the varieties separate. The varieties themselves have been sufficiently defined in the foregoing and in the figures.

The head is small, sagittate in a marginal view, oblong in a lateral view. Near the anterior end is a constriction. The part in front of this constriction is short, projecting in a thick lip with rounded edges and bluntly rounded in front, nearly circular or somewhat quadrangular when viewed in front, but usually with a slight lateral emargination corresponding to the faces of the bothria. The latter organs are two in number, lateral, oblong, rather deeply hollowed out in the center with moderately thin edges, free and slightly flaring at the posterior ends. In most of the specimens of this lot the edges of the bothria are irregularly crimped or crenulate. A cross-section of the head shows that the edges of the bothria are thin, so that a section made transversely through the middle of the head resembles two crescents with their convexities truncated and then applied to each other. The bothria in most of the individuals (var. β) extend to or beyond the posterior edge of the first segment. In one it reached quite to the posterior edge of the second segment. There is no neck. The central core of the head becomes gradually thicker and broader until it merges into the first segment. A series of transverse sections carried on into the second segment shows the outer tissues sloughing off until a concentric ring is formed which indicates the posterior part of the first segment where it overlaps the anterior part of the second.

The anterior part of the body is rather slender, and slightly flattened, usually linear for a distance of 30 to 40^{mm}, then increasing in breadth uniformly until the greatest breadth is attained, which is about the middle of the total length. This breadth is maintained until near the posterior end where the body becomes distinctly narrower. In some the posterior end tapers to a blunt point. This is notably the case in var. α. One specimen, No. 4 of table, p. 350, measuring 610^{mm}, was linear for the first 50^{mm}. In the next 75^{mm} it increased in breadth gradually to 3.5^{mm}; 60^{mm} farther on it had increased in breadth to 6^{mm}. This breadth it maintained within varying limits to near the posterior end. In var. α the breadth of the first part of the body increases slowly but uniformly. At a distance of 25 or 30^{mm} it is 1^{mm} broad; 45^{mm} from the head it is 2.5^{mm} broad; 100^{mm} from the head 5.5^{mm} broad.

The segments which immediately follow the head are decidedly funnel-form, the large posterior edge of each inclosing the narrow anterior end of its successor. These in some cases are followed, in the anterior part of the body, by segments with parallel lateral margins, and with the

posterior edge thin and flaring outwards at nearly a right angle. Sooner or later, however, these segments are crossed by transverse rugæ, which give rise in turn apparently to secondary and tertiary segments until, in the widest part of the body, the segments or pseudo-segments become so crowded together as to resemble transverse wrinkles.

The following details with regard to the feature just alluded to, although taken from var. α, do not differ materially from what is shown by var. β.

About the fifty-second segment, which, in this individual is 20^{mm} from the head, a median transverse line makes its appearance, which becomes more strongly marked on the next, and on the next yet more pronounced. The fourth primary segment following the fifty-second was plainly divided into two secondary segments, the posterior segment of this pair being the larger. Beyond this point the segments are alternately larger and smaller, until about the seventy-eighth segment where the same phenomenon is repeated, the secondary being divided into incipient tertiary segments, the transverse lines become more distinct, and about the eighty-second segment give rise to distinct tertiary segments. At a distance of 56^{mm} from the head the primary segments can still be distinguished by their more prominent projecting posterior edges. The latter are at this point about 1.25^{mm} apart. Between them are six segments which are alternately larger and smaller. The primary segments can be traced for at least 200^{mm} from the head. Beyond that point no difference could be discerned, all the segments having become very much crowded and rugæform.

In another individual the secondary segments begin about the forty-fifth from the head, and the tertiary about the sixty-fifth. The distinctive features of the primary segments are quickly lost.

In No. 4 of the table the forty-sixth and forty-seventh segments are divided into secondary segments, but no further indication of secondary segments is visible until the sixty-third. Tertiary segments begin about the eighty-fifth segment, or 65^{mm} from the head.

Another specimen, No. 5 of table, is somewhat narrower in habit than the others, and presents more irregularity in the formation of secondary and other segments. The third and fourth segments are welded together. Between the fifth and sixth, sixth and seventh, seventh and eighth segments is a single secondary segment. Each of the next three primaries bears two secondaries. On each of the next two primaries there are three secondaries. On each of the four following primaries there are five secondaries. These may be better described as primary segments of two sizes. There is no indication that the smaller are derived from the larger, and these irregularities may be due possibly to differences of contraction. Secondary segments like those observed in the other specimens occur about the ninetieth segment, a distance of some 40^{mm} from the head. In this individual the greatest breadth is 4.5^{mm}; breadth at posterior end 1.4^{mm}; length of posterior segments about .65^{mm}.

In many of these specimens the segments become rather indistinct near the posterior end on account of transverse wrinkles on the segments which resemble the dividing line between two segments. In No. 4 the segments 12mm from the posterior end are 3.5mm wide and .5mm long. The last but one measures 1mm in length and 1.8mm in breadth at the front end, narrowing to 1.2mm at the posterior end. The last segment is 1.4mm broad and 1.25mm long, tapering to a bluntly rounded point.

The following measurements are introduced for the purpose of furnishing a basis of comparison between the two varieties. It will be observed that No. 1 differs uniformly in its head dimensions from the others, between which there are but few differences. No. 1 is var. α, the others are var. β.

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*
Length	655.00	470.00	534.00	610.00	660.00
Length of bothria	0.86	1.54	1.60	1.54	1.80
Breadth of head, anterior, marginal	0.44	0.74	0.80	0.76	0.78
Breadth of head, anterior, lateral	0.48	0.80	0.80	0.74	0.78
Breadth of head, posterior, marginal	0.70	1.36	1.34	1.40	1.46
Breadth of head, posterior, lateral	0.54	0.84	0.80	0.76	0.80
Breadth of first segment, anterior, marginal	0.18	0.40	0.68	0.50	0.66
Breadth of first segment, anterior, lateral	0.50	0.90	0.90	0.80	0.90
Breadth of first segment, posterior, marginal	0.50	0.80	1.06	0.76	1.08
Breadth of first segment, posterior, lateral	0.56	1.24	1.26	1.22	1.42
Length of first segment	0.26	0.30	0.34	0.36	0.32

Some of the measurements in numbers 2 to 5 marked first segment were really taken from the second segment, on account of the anterior part of the first segment being obscured by the overlapping bothria. The difference between the first and second segments is, however, in all cases very slight.

In variety α one of the lateral faces is marked by two distinct linear grooves, parallel with the margins, each about 1.5mm from the nearest margin. These are not distinct until about 125mm back of the head; are most distinct in the middle of the body, but continue to the posterior end. Similar lines occur on the opposite face, but they are very faint. They probably outline the water vascular canals. They were not seen in the other specimens.

The presence of ova is indicated in the alcoholic specimens by a dark median line which, in var. α, begins 135mm back of the head, and continues to within 6mm of the posterior end. In the other specimens the ova begin at about the same point. In some (Fig. 9) the ova continue to the last segment, and the posterior segments are rather distinct. In one individual of var. β there is the same kind of termination to the body as in var. α. Several of the specimens had been mutilated in collect-

ing, so that it was not possible to determine the normal condition of the posterior segments.

The ova are amber colored, oval, .07 and .04^{mm} in the two diameters. They are usually collapsed on one side into a bowl-shape. They are observed in some cases lying in small clusters and making a zigzag line on one of the lateral faces of the strobile. The masses of ova within the strobile do not seem to coincide with the segment, but, as they develop, push into the adjoining segments, so that the median line of ova is an almost continuous one.

The cirrus is long, slender, marginal, irregularly alternate, and protrudes from the middle part of the margin of a segment.

The cirrus bulb is pyriform, and lies with its larger end towards the middle of the body. It is directed a little posteriorly, and extends a little beyond the marginal vessel of the water vascular system. The longest cirrus observed measured 1^{mm} in length, and was .04^{mm} in diameter at base, and .02^{mm} in diameter at the apex. The segments are deeply wrinkled at the marginal genital aperture, the wrinkle extending about one-third way to the median lateral line.

The marginal vessels of the water vascular system can be easily traced when the specimens are placed in glycerine. Their position is shown in the figures. It will be observed, from Fig. 6, that the vessels unite at the posterior end, at which point there is a terminal pore-like pit.

The foregoing remarks are based on what could be made out without the aid of thin sections. On account of limited time from other duties, and the large amount of material upon which I have to report, I can do little at present in working out the detailed anatomy of the Entozoa referred to me for identification. I have made, however, in this case a few sections which enable me to demonstrate some points in the anatomy of this worm that may be properly recorded in this place.

Anatomy of the head and first segments.—Both transverse and longitudinal sections of the head and first segments and of mature proglottides were made from specimens stained *in toto* in carmine and hæmatoxylon, respectively.

The sections were about .02^{mm} thick.

The first two transverse sections of the head are densely and coarsely granular at center, finer toward the edges, with fine interlacing muscular fibers. The coarse granules are evidently the cut ends of longitudinal muscular fibers. In shape they are irregularly triangular. In the third section the interlacing fibers are more plainly seen and there are besides four clear spaces so situated that if they were joined by straight lines they would mark the four angles of a parallelogram. The coarse granules still constitute the mass of the tissue. In the next three or four sections the clear spaces are better defined and the longitudinal muscles are not so dense at the center. Each clear space is joined to its fellow along the longer side of the parallelogram by a curved line which is convex towards the center. Transverse muscular striæ, .002^{mm}

in diameter and .014^{mm} apart cross each other at right angles in the center, more or less obliquely in the vicinity of the clear spaces. These transverse muscular fibers appear as curved lines with their convexities towards the center of the head. The cross-sections of the longitudinal fibers, while irregular in outline, have a tendency towards triangularity. The greatest diameter of any single fiber measured was .005^{mm}. Other larger patches were observed, but they seem to represent the coalescence of two or more single fibers. The sections of the head are at this point elliptical. The cuticle is not clearly defined. The clear spaces gradually lose their distinctness on account of the increase of transverse fibers. At about the sixth section the transverse fibers begin to be arranged in fasciculi. Two of these fascicles are quite evident and join opposite pairs of clear spaces in the direction of the greater diameter of the section and along the longer sides of the central rectangular space. The longitudinal fibers become less dense along lines which radiate from the angles of the central rectangular space, while between these radiating lines they appear to have become massed together more densely. The clear spaces do not have definite outlines and are certainly not closed vessels. They are crossed by the radiating transverse fibers and appear to have loose cellular or granular contents. This feature is quite evident in the first sections, where nucleated cells were observed in the continuation of these irregularly outlined vessels in longitudinal sections of a specimen stained with hæmatoxylon. Next the two dense masses of longitudinal fibers, which lie opposite and outside of the longer sides of the central rectangular space, appear as two rings of dense granules with a clear center, which is made up of two parts, an inner of transverse or radial fibers, and an outer reticulated part. These two parts soon separate. The inner one, with a deep notch in the middle, is the extreme anterior end of a bothrium, the outer reticulated part is the cuticle of the posterior side of the apical disk of the head. This feature continues for several sections, and shows that the anterior ends of the bothria are above the constriction and near the apex of the head. Transverse fibers predominate in the vicinity of the constriction, while longitudinal fibers predominate in the anterior disk. This fact was confirmed by both transverse and longitudinal sections. The cuticle immediately in front of the constriction is clearly defined and appears in transverse section as a dense layer of fine striæ. It is about .011^{mm} thick.

Clearly defined sections of aquiferous vessels were not found in sections made at the constriction or anterior to it.

The outline of a section at this point is quadrangular, with bluntly rounded angles and concave sides; the two sides on which the bothria lie are very deeply notched. Fascicles or bands of transverse fibers run in a very complicated way from one side to the opposite side and also diagonally from one side to the adjacent side. The longitudinal fibers do not have at this point any definite arrangement. A little farther back the corners of the quadrangular sections project and curve

toward each other where the thin lips of the bothria are cut through. The bottom of the bothria consists of a layer about .03mm thick of dense transverse interlacing striæ. Along the sides the tissue is looser, with open cellular spaces about .005mm in diameter. There is here a more definite arrangement of longitudinal fibers, which now lie in four masses, one in each of the projecting corners of the quadrangular sections. Each of these is at first somewhat circular with a clear central space, a character which is presently lost. A narrow layer also lies along the face of each bothrium immediately under the layer of transverse tissue. Another mass lies opposite the middle of each of the shorter sides of the section. The transverse fibers still predominate, however, and even the masses of longitudinal fibers are quite abundant.

Two large, irregular, clear spaces, crossed by a few transverse fibers and filled with a granular substance, which is but slightly stained by the carmine, indicate the continuation of what was seen in front of the constriction. Besides these there are a number, at least four on a side, of small spaces with definite outlines, which on account of their irregularity in contiguous sections are readily interpreted to be sections of aquiferous vessels which pursue a spiral course. This was further proved from longitudinal sections. Near the middle of the head a transverse section has the appearance of two crescents pressed together by their convex sides. The distance through the head from the bottom of one bothrium to the bottom of the other is only .2mm, while the opposite diameter is .56mm. Several vessels, as many as six on a side, were counted beside the two large irregular, nervous (?) vessels. Each of the latter is .054 by .032mm in its two diameters, the longer diameter corresponding to the longer diameter of the sections. At this point the longitudinal fibers are pretty evenly distributed. Back of the middle the central part of the head grows thicker and wider; the margins, which at first were gently concave and then strongly emarginate, assume a more and more even outline, then bulge out into the rounded convex outlines of the margins of the segments. The head is thus seen to pass imperceptibly into the first segment.

In some of the sections there were remains of what appeared to be a dense layer of columnar epithelium lining the bothria. This layer was still adherent to the inner edge of the thin lips of the bothria and extended nearly to the bottom of the pit. Becoming separated from the underlying cuticular layer the detached portions break up into groups of curved cells. The thickness of this layer, coinciding with the length of the component cells, is .008mm.

The sections which passed through the posterior parts of the bothria also cut the posterior parts of the first segment. As the sections progress through this part, an outer concentric layer, about .09mm thick and containing radiating, transverse, and circular fibers, separates, leaving a central oblong core, which contains the aquiferous and nerv-

ous (?) vessels. The body, indeed, can not be said to be distinctly segmented.

The water vascular system at this point consists of four principal vessels, situated in pairs, each pair lying on the inner side of what I take to be a lateral nervous vessel. The diameter of the aquiferous vessels is from .013 to .027^{mm}. The two nervous vessels are larger, being from .027 to .054^{mm} in their longer, and slightly less in their shorter diameter. Each of the latter is flanked on the sides next the lateral faces by two other small vessels which appear to be of the same nature. No nucleated cells were observed at this point in these vessels, but they contain a net-work of connective tissue, some of the meshes of which are filled with finely granular substance, while others are empty.

An oblong, central part of these sections has the two nervous vessels at its extremities; in it also lie the aquiferous vessels, with an occasional transverse vessel. This central space has a few transverse fibers crossing it, but is made up for the most part of fine connective tissue in which are numerous small cells which are deeply stained with carmine, averaging about .003^{mm} in diameter, and each containing several dark granular specks. These cells are quite different in appearance from the cut ends of longitudinal fibers, and present the same appearance in both transverse and longitudinal section. Moreover, the central core does not show longitudinal fibers in longitudinal sections. Granular cells, similar to the above, are scattered pretty generally through the tissues.

The longitudinal muscles of the body are arranged in four principal bands, two lateral and two marginal. These muscles are very strongly developed. Outside the four bands of longitudinal muscles is a layer of circular muscles with radiating and longitudinal fibers interspersed.

A longitudinal section shows the lateral nervous canals to be somewhat irregular in diameter and without definite walls. They pursue, in the main, an undeviating course, while the aquiferous vessels, which, with reference to the nervous canals, lie towards the center of the body, have a pretty uniform diameter, and pursue an irregularly spiral course. A few nucleated cells were observed in the nervous canals.

Further investigation is needed to demonstrate the exact nature of vessels which I have called nerves.

Anatomy of the proglottides.—Sections made near the posterior end of one of the longest strobiles show an outer, dense granular layer in which are numerous very fine circular fibers with a few radiating fibers. Within this layer, which is about .1^{mm} thick, is another layer of very powerful longitudinal fibers. These occur in fascicles averaging .027^{mm} in diameter. This layer is limited on both sides by a thin layer of circular fibers; it is complete except at the two margins, where there is a short interval where longitudinal fibers are wanting.

The reproductive openings are marginal, about the middle of the seg-

ment, now on one side, now on the other, with a tendency for several to succeed each other on the same side. The cirrus arises from a pear-shaped pouch, whose walls are composed of fine interlacing contractile fibers. In most cases the cirrus is retracted and lies coiled up within the pouch. The larger end of the pouch is directed towards the median line, at its base lies the vas deferens in a voluminous mass. The testes occupy considerable space. The large granular masses, of which they are composed, are most abundant towards the margins, where they fill the central parts of the proglottis. Towards the middle of the proglottis they are displaced by the female genital organs.

The ovaries are situated near the posterior edge of the proglottis near one of the lateral faces, which, for convenience, I will call the ventral face. The ovary itself viewed laterally is an oblong, many lobed organ, made up of globular, nucleated cells, some of which measured from .008 to .013^{mm} in diameter. The ovary in its widest place equals about one-third the breadth of the proglottis, and is about one-half as long as broad. Its average depth in the specimens measured is less than .2^{mm}. From its anterior part the vagina arises and passes outwards towards the margin, then ascends dorsally on a level with the cirrus pouch, the dorsal edge of which it follows closely. It opens near the small end of the cirrus bulb, so that the two organs, cirrus and vagina, have a common cloacal opening on the margin of the proglottis. The position of the vaginal opening was demonstrated only after long and careful search. The oviduct originates at the anterior part of the ovary and is continued into a long and much convoluted tube, which in all the segments, except those that constitute the anterior slender part of the strobile, contains numerous amber-colored eggs.

Before sections were made, ova were seen in little clusters on one of the lateral faces of the body. When sections were made it was discovered that these pores not only actually exist, but that they are of invariable occurrence on the mature segments. They are not in any sense caused by a rupture of the wall of the proglottis, but are definite apertures. They lie on the ventral side, that is, the same side of the proglottis as that on which the ovary lies, and near the anterior edge, a little to one side or the other of the median line. They thus form an irregular zigzag line along the middle of the ventro-lateral face. The oviduct communicates directly with this excretory pore. Mature ova were found in what appeared to be rather immature segments. A shell-gland was demonstrated, somewhat doubtfully, however, in front of the ovary. The egg-inflated oviduct so crowded the middle space of the segment as to render it very difficult to make out the relations of the various parts.

It is to be noted that there is no really clear dividing line between the segments when seen in longitudinal section. The relationship of *Dibothrium* to *Ligula* is thus clearly demonstrated.

5. *Dibothrium plicatum*, Rudolphi.

[Pl. III, Figs. 1–6.]

Echinorhynchus xiphiæ, Gmelin, Syst. Nat., 3047. Zeder, Naturg., 162. Rudolphi, Entoz. Hist., II, 308.

Bothriocephalus plicatus, Rudolphi, Synops. 136 and 470, Pl. III, 2. Bremser, Icon., Pl. XIII, 1 and 2. Creplin, Nov. Obs. 87, Pl. II, 12–14; Ersch. and Grub. Encycl., XXXII, 297. Dujardin, Hist. Nat. des Helm., 614. Van Beneden, Mem. Acad. Belgique, XXXVIII, 36. Olsson, Lund's Univers, Årsskrift IV, 11, Pl. III, Fig. 66. Von Linstow Comp., Helm., 218.

Bothriocephalus truncatus, Leuckart, Zool. Bruchst., I, 37, Pl. I, 13.

Dibothrium plicatum, Rudolphi, Diesing, Syst. Helm., I, 591; Revis., Ceph. Par. 243. Wagener, Nov. Act. Nat. Cur., XXIV, Suppl. 71, Pl. VIII, 94, 95.

This Dibothrium is peculiar to the common sword-fish (*Xiphias gladius*), having never yet been found in any other host. Following is the description given of it by Diesing:

Head sagittate, compressed truncate at the apex, with oblong, lateral bothria. Neck long, somewhat terete, swollen at the base, segments very short, at length longer, with the posterior margin crisp-undulate.

I have referred to this species five specimens of Dibothria from the rectum of *Xiphias gladius*. The head and neck of each of these parasites were completely buried in the walls of the rectum. The part thus buried measured about 13^{mm}. The cavity in which the head and neck were inclosed was, in each case, an enlarged cyst-like space filled with transparent, watery lymph. These spaces were noticed on the outside of the rectum, lying immediately under the serous membrane, and were at first taken to be encysted larval cestods, but upon cutting into one of them the inclosed head and neck, except in one case, to be noticed further on, were observed to be attached firmly to the inner muscular layer of the rectum. After cutting away the remaining tissue from the enclosed necks they were found to be continuous with the bodies of some large Dibothria which lay in the lumen of the rectum and were attached to its walls. The color of the head and neck was bluish-white, that of the body grayish-yellow. After removal from their host the worms were placed in sea-water, where they at once contracted to about one-half their former length, while, at the same time, they became much broader and thicker, with the segments so crowded together that only their posterior edges were visible. They then had assumed the characteristic shape and appearance which is shown in the sketch (Fig. 1). Before they had thus contracted they bore a close resemblance to *D. manubriforme* (U. S. Fish Commission Report for 1886, pp. 456–458, Pl. I, Figs. 1–4). The length of one after thus contracting, exclusive of the head and neck, was 54^{mm}, while its greatest breadth was 12^{mm}. Another measured 66^{mm} in length, with a breadth of 7^{mm} throughout nearly its whole length, narrowing abruptly, however, at the last three or four posterior segments, which measured 2^{mm} in breadth.

The head is short, in preserved specimens oblong, or even orbicular in lateral view, sagittate, compressed in marginal view, blunt at apex. Bothria lateral, each with shallow concavity and thickened edges, posterior border slightly projecting. Length of bothria in two specimens 1.75^{mm} and 2.45^{mm}, breadth 1.58^{mm} and 2^{mm} respectively.

That part of the body may be conveniently called the neck, which, along with the head, is inclosed in the cyst-like cavity within the rectinal walls. It is broader than the head and quite irregular in outline. It is characterized by having the cuticle raised into several irregular, transparent folds. At places the neck is thus rendered much broader than the head. At the point, however, where the rectinal walls are pierced by the neck the latter is compressed on all sides and so reduced to a slender cylinder. At its base the neck enlarges abruptly, becomes transversely striated, and thus merges imperceptibly into the body proper.

Two alcoholic specimens yield the following dimensions for the head and neck:

Dimensions.	No. 1.	No. 2.
	Mm.	*Mm.*
Diameter of head, lateral	1.75	2 00
Diameter of head, marginal	.70	.88
Diameter of neck, lateral	2.85	2.45
Diameter of neck, marginal	1.75	1.40

The measurement for the marginal diameter of the head, given above, was made about the middle of the bothria. Of course the marginal diameter taken through the bases of the bothria would approximate that of the neck. The measurements of the neck were made a short distance back of the head and at about the broadest and thickest part of the neck. At the more slender, cylindrical portions of the neck, near the base, the diameter varies from .5 to 1^{mm}.

The body, at first elongated, when placed in sea-water and in alcohol becomes rather stout. It broadens abruptly back of the neck and soon attains its maximum breadth. In some specimens this is maintained until near the posterior end, in others the body tapers slowly towards the posterior end. The posterior mature segments are very narrow at their anterior end, with broadly flaring posterior borders. Where a few of these are retained on the strobile, they appear like a nest of cups of graduated sizes, with widely flaring lips, piled one within the other. In cases where the narrow posterior segments have been lost the posterior end of the strobile is often deeply emarginate. The segments begin immediately behind the neck, are extremely regular and very short. Their posterior edges are free and project at right angles to the axis of the strobile. They often become undulate with short, crisp folds, which fact imparts the peculiar characteristic appearance to the worm which doubtless suggested the specific name.

In a mature segment which had been placed in glycerine, it was seen that the reproductive aperture, in the shape of a prominent papilla was situated at the margin, or rather on the anterior face of the marginal projection. The diameter of the apex of this papilla, which doubtless represents the base of the cirrus, was .16mm.

A single small individual (Figs. 2 and 3), found entirely inclosed and free in a cyst-like cavity, which was filled with transparent, watery lymph, as in the case of the others, appears to be a young specimen of this species. In it the bothria are much more elongated than in the others and the head is truncate with a tumid border projecting on all sides and a minute papilla at the apex. Segments in the shape of fine transverse lines begin immediately behind the head. The posterior segments resemble those of the adult. The specimen is, in fact, a small copy of the larger ones whose bodies were dependent from the inner walls of the rectum. The dimensions obtained from measurements of this small specimen while it was still alive are as follows:

	Millimeters.
Length	13.0
Breadth of head at apex	1.2
Length of bothrium	3.0
Breadth of bothrium	1.2
Diameter of neck	2.0
Length of posterior segments	1.0
Breadth of posterior segments	1.5

The following data with regard to the anatomy of the segments were obtained from a study of a series of longitudinal and transverse sections of portions taken from the middle and the posterior end of an adult specimen. The appearance of these sections, particularly of the longitudinal ones, is very peculiar and indeed unique among the Dibothria. In a series of about ninety longitudinal sections carried through a piece taken from the posterior end of a strobile, only about one-third of the number proved to belong to the segments proper. The remaining two-thirds belonged to the prominent posterior edges which lie about .06mm apart. These edges protrude marginally as well as laterally to a distance equal to nearly one-third the total breadth of the strobile. In longitudinal sections, through the middle of the segments, these free edges form a pectinate border on each margin. Such sections resemble a comb with teeth on the two opposite edges. The teeth are of different shapes, some are acute, others club-shaped. These free edges of the segments consist of two muscular walls with a central space, which is filled with irregular granular bodies. The latter are probably a part of the reproductive system. The reproductive organs proper are borne, not exactly on the margins of the segments, but on one of the lateral faces of the marginal projection. The cirrus pouch is very muscular, and in median section is long, oval, or slipper-shaped. The outer part contains the invaginated cirrus, which seems to be a very thick-walled and muscular organ, at least at the base. The inner

part contains a narrow convoluted tube which appears to be a part of the vas deferens. The coils in the outer part when cut across appeared in section as concentric rings, thus proving that they were the coils of the invaginated cirrus. The coils in the inner part, in the same section, gave no evidence of concentric rings, but were filled with small granules. The latter had sharp outlines and were of nearly uniform size, .003^{mm} in diameter. There was in these sections no evidence whatever of a segmented condition of the body except in the projecting edges. The central part of the body appeared to be absolutely continuous.

The musculature, as revealed by a low magnifying power, consists of an outer circular layer, covered by the cuticle, and an inner longitudinal layer. The latter is very strongly developed. The fibers of which it is composed are many times larger than the circular fibers. They show by their irregular course, looking as if anastomosing with each other in an irregular network, that they were in a state of profound contraction at death.

In some transverse sections from the middle of the body, a convoluted tube was observed which lay beside the cirrus bulb and appeared to open at the outer end of that organ. It follows that face of the bulb which is toward the middle of the marginal projection. Its outer end is wide and appears to be a kind of *receptaculum seminis*. It can be traced to a glandular mass of uncertain outlines, presumably the ovary, in the middle of the segment. If this is the vagina, then both reproductive organs open marginally. It can not be a part of the vas deferens, because the latter was seen as a distinct tube, entering the base of the cirrus bulb and connecting with the coiled tube in the inner part of the bulb.

On a few segments from the middle of the body, small lateral openings were observed, which were situated about half way between the median line and the margin. These were on but one of the lateral faces and were not found on many segments. They are probably pores which communicate with the oviduct and are designed for the escape of ova.

The segments from the posterior end of the strobile have a space in the center filled with ova. These are large with thick shells and granular contents. The normal shape is long oval but owing to the apparently plastic nature of the shells they occur in very various shapes. Measurements of the largest perfect ones gave the length as much as .1^{mm}, with the shorter diameter from .046^{mm} to .063^{mm}. The shell as seen by transmitted light has a thickness of .0025^{mm}. A few ova were observed with one end truncated. From this fact I am led to suspect that the ova of this species may be provided with a terminal operculum for the escape of the embryos, but this can not be demonstrated from my mounted sections.

There are several discrepancies to be found in existing descriptions of this worm. Diesing and others recognize a neck. Dujardin states that there is no neck. I believe that there is no true neck, but that

that part of the body which becomes enveloped by the tissues of its host degenerates into a fleshy cylinder from which all traces of segments are lost. It is easy to see how this result can follow upon such conditions when it is remembered that about the only indication of a segmented condition is the thin projecting posterior edges of the segments, so that when these disappear the central core of the body would appear without segments. For convenience of description, however, it will be well to call that part of the body the neck which in the adult becomes so distinctly modified at the point of attachment.

Olsson states, with a query, that the genital apertures are lateral. Since the apertures in question occur about the middle of the free marginal edges of the segments, and the cirrus pouch lies wholly within that free margin, I think there should be no hesitation in saying that the genital apertures are marginal.

Habitat.—Xiphias gladius. Off Martha's Vineyard, Massachusetts, July 25, 1887. In rectum, five adult specimens, one young.

6. *Dibothrium rugosum* Rudolphi.

[Plate III, Figs. 7–10.]

Bothriocephalus rugosus, Rudolphi. Entoz. Hist., III, 42; Synops., 137. Leuckart, Zool. Bruchst., 57. Dujardin, Hist. Nat. des Helm., 617. Cobbold, Trans. Linn. Soc., XXII, 158, 159. Olsson, Lund's Univ. Årsskrift, IV, 10, Pl. III, Fig. 65. Von Linstow, Compend. Helm. 236.

Dibothrium rugosum, Rudolphi, Diesing, Syst. Helm., I, 591; Revis. Ceph. Par., 240–241. G. R. Wagener, Natuurk. Verh. Haarlem, XIII, 93.

For older synonymy see Diesing's Syst. Helm.

Head sub-sagittate, with oblong lateral bothria. Body with a median furrow and unequally articulate. Length, 300 to 900^{mm}.—*Diesing.*

Length, 300^{mm} to 1^{m}; breadth, 1.2 to 4^{mm}.—*Dujardin.*

Genital apertures marginal, irregularly alternate.—*Olsson.*

I have referred to this species a small lot of Dibothria from the intestine of the cod (*Gadus morrhua*). The specimens were collected by Mr. Thomas Lee, of the U. S. Fish Commission steamer *Albatross*, on the Grand Banks. Mr. Lee stated that he examined one hundred and fifty cod and found parasites in but a few of them.

Each of the specimens in this lot has the head and anterior part of the body buried in the pyloric cæca, where they have undergone degeneration to such an extent that no appearance of bothria remains. Around the parts thus enveloped by the cæca is a yellowish waxy deposit, the degenerated tissue of the cæca. This adventitious tissue invests the worm so closely that it would be absolutely impossible for the parasite to free itself from its host. This feature is mentioned also by Cobbold, who makes the following statement with regard to Dibothria from the cod:

In a cod examined on the 15th of March, 1855, two specimens of *Bothriocephalus rugosus* had severally attained a length of 15 inches, and their anterior segments, for an inch or more downwards, were so firmly impacted within the pancreatic cæca

that it was found impossible to dislodge them without injuring the filamentary head and neck. As if to make the anchorage doubly secure, the cartilaginoid thickening of the invaded pancreatic cæcum had degenerated into a calcareous and contracted cylinder, twisted upon itself in various ways.

The specimens were in alcohol when they were submitted to me; I am therefore unable to give measurements of living specimens.

The largest of the specimens measures 655^{mm} in length. The anterior part for a distance of 20^{mm} was buried in one of the pyloric cæca and was removed with difficulty, by cutting away the enveloping cæcum. The latter had degenerated into a brown, waxy secretion, which was enveloped by the serous coat, and formed a much twisted, rigid tube surrounding the anterior part of the worm. When this encasing tube was removed, it was found that all appearance of bothria or anterior segments had disappeared. That part of the worm which had been inclosed in the tube was reduced to a slender white filament about .5^{mm} in diameter. In another specimen the inclosed anterior part was irregular in outline and graduated into a yellowish, corneous substance at the tapering apex. In this case the anterior end of the parasite had undergone a degeneration of its tissues similar to that of the cæca of its host.

The body is not distinctly segmented at first, but is crossed by innumerable fine wrinkles. The breadth near the anterior end is 2.5^{mm}. It narrows abruptly at the point of entrance to the cæcum. Near the middle of the body the breadth is 3.5^{mm}, the length of the segments .85^{mm}, increasing to 1^{mm}. The posterior part of the body, for a distance of about 40^{mm}, is much wider, with crowded segments. Breadth, 6^{mm}; length of segments, .45^{mm}. This is evidently due to unequal contraction. Thickness of the body about 1^{mm} in front, and approximating 2^{mm} in median and posterior segments. Another specimen had the following dimensions: Length, 560^{mm}; anterior part, inclosed in cæcal tube, 6^{mm} in length, .4^{mm} in diameter; breadth near anterior end, 2.5^{mm}; middle, 5^{mm}; length of median segments, .7^{mm}; breadth at beginning of posterior fourth, 4^{mm}; length of segments, 1^{mm}; breadth at posterior, 6^{mm}; length of posterior segments, .45^{mm}; body rather plump, posterior half about 2^{mm} thick.

One of the lateral sides of the strobile has a row of apertures making an irregular zigzag series along the median line. These apertures are oblong, the long axis coinciding with the long axis of the body. These lateral apertures were at first naturally taken to be the genital apertures. A careful examination with an ordinary lens revealed what appeared to be marginal apertures. These were indistinct, but I was led to make transverse and longitudinal sections of a series of segments in order to demonstrate the position of the genital apertures.

The first sections were made from segments taken from the posterior end of the body. The marginal position of genital apertures was at once proved. In all cases where they were observed the external openings were obscured by the close approximation of the sides, so as to form

a wrinkle when viewed from the exterior. This fact explained the difficulty experienced in finding the marginal apertures with a superficial examination. The lateral apertures seem to be designed for the escape of ova.

The mature segments, as shown by these sections, are simply sacs with muscular walls for the protection of the eggs. A transverse section is long oval, 2.6 by 1^{mm}. The lateral muscular walls are from .1 to .16^{mm} thick, the marginal walls from .16 to .24^{mm} thick. The segments are separated from each other by a narrow partition from .02 to .06^{mm} thick. A few irregular shreds of muscular tissue and delicate strands of connective tissue extend into the hollow, central part of the segment. Otherwise, the segments are filled with granular bodies about .03^{mm} in diameter. In sections stained with hæmatoxylon these are colored violet; and each is closely invested in a transparent, unstained membrane which has an irregular or tattered outline. Some of these granular bodies which lay near the muscular wall of the segment were inclosed in a net-work of muscular and connective tissue. In these the investing membrane was not so prominent as in those masses which lie farther from the walls of the segment. It would seem, therefore, that the membranous investment of the granular masses is a result of the degeneration or transformation of the muscular and connective tissue of the interior of the segment. In the vicinity of the lateral apertures several collapsed shells of ova were observed. These were unstained, and were .027 and .016^{mm}, respectively, in the two diameters.

One undoubted ovum was seen with granular, stained contents, and a very thin, transparent shell, .02 and .016^{mm} in the two diameters. In order, if possible, to prove the real nature of these granular masses I made transverse and longitudinal sections of postero-median segments. In these segments the ovary is voluminous and composed of distinct nucleated cells, nearly circular in outline and from, .008 to .014^{mm} in diameter. The nuclei were about .0025^{mm} in diameter. The ovary lies at the middle of the posterior part of the segment with its greatest length transverse to the axis. It equals a little less than one-fourth the breadth of the segment and about one-fourth the length. These proportions must be subject to considerable variation, inasmuch as the ovary disappears completely in the posterior segments. At its thickest point, the ovary extends from the inner limit of one lateral muscular wall to the other. The ova are already abundant in these segments. They are enveloped in a proper shell, which is thin and has an irregular outline, owing to a wrinkling of the surface. This wrinkling or corrugation of the surface is apparently due to a contraction of the protoplasmic contents. They are approximately circular in outline, their average diameter being about .025^{mm}. From a comparison of sections made from postero-median segments with those from posterior segments I am led to believe that the granular bodies contained in the latter are ova with incomplete membranous shells.

The testis, in the postero-median segments, is represented by several large granular masses situated towards the marginal portions of the internal cavity. A convoluted tube, lying at the base of the cirrus bulb and communicating with it, is evidently the vas-deferens. This tube appears finely fibrous as if filled with fine filamentary particles. I have noticed a similar appearance in some living cestods in which case the presence of spermatozoa was demonstrated.

I was not able to fix the position of the vagina to my entire satisfaction. In a few sections the cut end of a tube was observed near the cirrus bulb and on its posterior side. This, if it represent the vagina, would indicate that that organ opens behind the cirrus. Olsson, however, figures the vagina of *D. rugosum*, as opening anterior to the cirrus. I may be able to clear up this matter by further examination of the material at my disposal.

Musculature of posterior and postero-median segments.—In passing from the exterior of the muscular wall of a posterior segment to the interior, one finds first a thin cuticle, next a thick, dense granular layer, in which there are very numerous radial fibers which in turn penetrate the third or inner layer. This third layer consists for the most part of very large longitudinal fibers arranged in fascicles. The fascicles, in transverse sections, are somewhat triangular, with the apex of the triangle directed toward the exterior. The triangular transverse section of one of these fascicles measured .05 mm in length, .03 mm at base, and .013 mm at the apex. These fascicles are largest along the lateral sides, and smaller but more numerous at the margins. In longitudinal sections they appear as broad parallel bands of muscular fibers, the individual fibers of which are about .002 mm in diameter.

The reproductive organs are irregularly alternate and open on the margin of the segment near its anterior edge. In the mature segments only the male organ could be made out. The cirrus was retracted and lay in a slender pouch. This pouch lay wholly in the muscular wall with its base near the interior limit of the wall and its apex at about the limit between the outer granular layer and the inner layer of muscular fasciculi.

The musculature of the postero-median segments was plainly shown in the sections, and some additional data were obtained. The parts are an outer, dense granular layer with fine radiating fibers. On the inner side of this layer is the layer of longitudinal fasciculi. The latter are really immersed in the granular layer. Transverse sections of these bundles are oblong, usually narrowing a little toward the exterior end, occupying a radial position. The largest lateral ones are fully .08mm long and .027mm broad. They are separated from each other by spaces about as wide as their own breadth, and filled with granular and fibrous tissue, in which radiating fibers predominate. On the inner side of the layer of longitudinal fibers is a thin layer of fine circular fibers which

separates, by a sharp division, the muscular wall from the inner cavity of the segment, in which lie the genital organs. This layer of circular fibers spreads out into a thin sheet of fine fibers, at intervals, to form the septum between two adjacent segments. The fibers of this partition are transverse, and run in the direction of the longer diameter of the segment; that is, from margin to margin. This partition is confined to the inner portion of the segment, and does not extend into the muscular walls. Elsewhere in the segment the inner space is crossed by fascicles of fine fibers which pass from one of the lateral muscular walls to the other without interruption, except where displaced by the developing ova.

Following are the measurements of a transverse section of a posteromedian segment: From margin to margin, 2.7^{mm}; from side to side, .9^{mm}; thickness of muscular walls, .3^{mm}; marginal diameter of inner cavity, .2^{mm}; lateral diameter of same, .36^{mm}.

Habitat.—*Gadus morrhua*, pyloric cæca, August 8, 1886, Grand Banks.

Family II.—TETRABOTHRIIDÆ *Diesing.*

Tetraphyllidæ (in part) Van Beneden.

Subfamily I.—PHYLLOBOTHRINÆ Van Beneden.

ANTHOBOTHRIUM Van Beneden.

The generic characters are thus summarized by Diesing: Body elongated, articulate, depressed. Supplemental disks (*auxiliary acetabula*), none. Head separated from the body by a neck. Bothria four, opposite, entire or unilocular, cup-shaped or subglobose, affixed by a contractile pedicel, highly versatile, unarmed. Genital apertures marginal.

7. *Anthobothrium laciniatum*, spec. nov.

[Plate III, Figs. 10–13, and Plate IV, Figs. 1–3.]

Head with four bothria, pediceled, trumpet-shaped, but capable of much diversity of form. Faces of bothria concave, with entire circular margins, but often folded and otherwise distorted by contraction. The head proper, exclusive of the bothria, is very small, often in the living worm appearing to be separated by a slight constriction from the first segment. Neck, in one variety, none, or very short; in another, variriable in length, but evident, cylindrical, or quadrate, and terminated behind by four laciniæ. First segments usually much broader than long, rather quadrate, *i. e.*, rectangular in cross-section, laciniate. In some the slender laciniæ of one segment overlap the succeeding segment, and are longer than the body of the segment. In other cases the anterior part of the body is extremely attenuated, in which case the anterior segments may be considerably longer than broad; the laciniæ are then only about one-third the length of the segment proper. In yet

other cases, and usually in those with evident neck, the laciniæ, instead of being long and slender, are short, stout, and truncate at the distal end. Median segments short and crowded, somewhat flattened, and with bluntly rounded laciniæ, or with a broad crenulation on posterior edge. The following segments increase in length, becoming at first as long as broad, subsequently longer than broad. The posterior segments, which may be three times as long as broad, frequently have the anterior end constricted into a short button-like process. The laciniæ persist, but are shorter, broader, and more rounded than at first. Sometimes the posterior edges of the segments are reflexed.

Genital apertures marginal, approximate, about the anterior third or fourth. Length, 25^{mm}.

Habitat.—*Carcharias obscurus*, spiral valve, Wood's Holl, Massachusetts, August, 1884; July 25, 1887, and August 12, 1887.

This species is near *Anthobothrium cornucopia* Van Beneden, from *Galeus canis*, but differs from it in its smaller size and relatively short neck. The length of *A. cornucopia* is given as 250^{mm}, while the maximum length of *A. laciniatum*, so far as I have observed, is 25^{mm}. Although no specimens were found whose proglottides contained ova, many were found in which the posterior segments were in other respects mature, and separated naturally from the strobile.

Amidst the great variety of forms represented by this species there are two which differ so much from each other that it may become necessary to classify them as constant varieties, in which event they may be named from their principal differential characteristics, var. *brevicolle* and var. *filicolle*.

The former is characterized by having a short or even no proper neck, and usually slender, sharp-pointed laciniæ on the first segments. The latter has an evident neck, and often short, broad, truncate laciniæ on the first segments. For the present, however, I prefer to regard these apparent varieties as simply different conditions of contraction, on account of which the short neck of some becomes more or less elongated in others.

In my explanations of figures I have, for convenience, made use of the terms var. *brevicolle* and var. *filicolle*. These and other characteristic forms are further described in the following detailed account of the species.

I have obtained this parasite on three different occasions, each time from the same host, namely, the dusky shark (*Carcharias obscurus*).

Following are measurements of specimens mounted in Canada balsam. The specimens were collected in August, 1881.

Dimensions.	No. 1.	No. 2.	No. 3.
	mm.	*mm.*	*mm.*
Length	21.50	16.00	6.00
Breadth of head	.83	.76	.60
Length of bothrium	.50	.40	.34
Diameter of bothrium, average	.30	.24	.30
Diameter of pedicel at base	.12	.10	.10
Length of neck	1.80	1.10	1.00
Diameter of neck near head	.09	.12	.06
Diameter of neck, base	.14	.12	.20
Length of first segment	.16	.32	.04
Breadth of first segment, front	.12	.10	.16
Breadth of first segment, rear	.16	.12	.16
Length of last segment	1.36	1.08	.68
Breadth of last segment	.56	.56	.18
Number of segments	62	65	60

In No. 1 the anterior segments are squarish, quadrate in cross-section, their posterior corners extended into laciniæ, which, like those at base of neck, are short, stout, and truncate at distal end. In No. 2 the laciniæ at base of neck are like those in No. 1, but on the first segments they are rather slender and not truncate. In No. 3 the first segments are very short and much crowded and the posterior segments have their laciniate borders reflexed like a collar. The last two segments are also somewhat distorted and show a tendency to bend rather sharply towards one margin. This specimen is evidently younger than the others and the variations which it exhibits may be due to differences in age and conditions of contraction.

The laciniæ on the posterior segments of Nos. 1 and 2 are short and broad. The bothria in all are terminally verticillate with conical pedicels that enlarge rapidly towards the face, which is limited by a thick muscular margin.

The following measurements were obtained from living specimens which were collected July 25, 1887:

Dimensions.	No. 1.	No. 2.
	mm.	*mm.*
Length	19.00	20.00
Breadth of head	.80	.....
Diameter of neck, average	.16	.06
Length of neck	.32	1.60
Length of first segment	.18	.44
Breadth of first segment	.18	.16
Length of last segment	1.80	1.00
Breadth of last segment	1.06	.16
Number of segments	120	.....

In No. 1, all the segments were remarkably clear cut and definite. The posterior end of the neck and first segment laciniate. At about the twenty-fifth segment back of the head the lappets become rounded and the segments closely crowded together, with a broad emargination on the posterior edge. This emargination gradually deepens as the segments become broader. At about the eightieth segment it becomes a deep round notch which persists in the mature segments. The genital apertures were marginal at about the anterior fourth. The bothria were very flexible and the pedicels extensible. The individuals in this lot exhibit the same varieties noticed in the two other lots. Some of these varieties are described in connection with the lot collected August 12, 1887. It is to be noted, however, that the differences that appear to be so profound in the alcoholic specimens were not so obvious in the living specimens.

The following measurements are of specimens belonging to a lot collected August 12, 1887; No. 1 a living, Nos. 2 and 3 alcoholic specimens:

Dimensions.	No. 1.	No. 2.	No. 3.
	mm.	*mm.*	*mm.*
Length	13.50	22.00	14.00
Breadth of head	1.04	1.20	.56
Length of bothrium, with pedicel	.52	.66	.30
Diameter of bothrium	.42	.....	.....
Diameter of pedicel at base	.....	.04	.12
Distance to first segment	.20	.....	.....
Diameter of neck	.10	.....	.....
Length of first segment	.06	.13	.04
Breadth of first segment	.18	.07	.16
Length of last segment	2.00	1.80	1.80
Breadth of last segment	.76	.60	.52
Number of segments	74	70	80

In this lot there were five specimens. They were associated with one specimen of the new species, *Platybothrium cervinum*, eight specimens of *Orygmatobothrium angustum*, nine of *Phoreiobothrium lasium*. All were in the spiral valve. There was also one young purple-red *Rhynchobothrium* adhering to the mucous membrane of the pyloric part of the stomach. The place of attachment of the latter parasite was locally inflamed. There was also another ulcerated spot near by.

In all the *Anthobothria* of this lot the first segments begin almost immediately behind the head, without an evident neck, and this, too, in specimens which are much attenuated in front as well as in those which are much contracted, so that the first segments are short and crowded together.

Two of the alcoholic specimens have the anterior segments very much attenuated. The bothria also are very much altered in shape from what was observed in the living specimens. In them the pedicels are elon-

gated and slender, the bothria surmounting them as flattened or collapsed disks. No perceptible difference could be noticed in these specimens while they were in sea-water. When placed under the compressor, one of them became somewhat attenuated as shown in the sketch (Plate IV, Fig. 1).

No. 2 of the above table was probably the specimen which was kept for some time under the compressor in order to obtain a sketch, and when transferred to the killing fluid, its tissues still retained the position they were forced to assume under the compressor. The bothria in this alcoholic specimen are irregular patellate, mounted on long slender pedicels, and the first segments are very slender, nearly twice as long as broad. The laciniæ are slender pointed and have a tendency to stand out at right angles to the axis of the strobile. In the other alcoholic specimen, No. 3, of the above table, the bothria, although somewhat distorted, have not changed their shape materially from that shown in Fig. 12, of Plate III, sketched from a specimen lying free in sea-water. The bothria are trumpet shaped, pedicels narrow at base but not elongated. The anterior segments are crowded, three or four times as broad as long, with slender sharp pointed lacinæ. The posterior segments in all the specimens are, in the main, alike.

The bothria in two of the specimens in this lot show a peculiar kind of modification, resulting from contraction, which, if but a single specimen were found and so modified, might prove misleading to the identifier. In these, when viewed in certain positions, each bothrium appears to be divided almost completely into two loculi, by a transverse constriction. A careful study of this peculiar distortion reveals the fact that the margin of the bothrium is still entire and the appearance of a constriction is caused by a protrusion of a part of the thin tissue which makes the bottom of the hollow face of a bothrium. The latter is transparent, and the thick, muscular, marginal rim of the bothrium showing through it accounts for the deceptive appearance of two loculi on the face of the bothrium. This same phenomenon was noticed in specimens belonging to the second lot. (See Plate IV, Fig. 2.)

Anatomy of posterior segment.—In one of the posterior segments from a specimen belonging to lot 3, the marginal genital aperture was .6^{mm} from the front end. This segment was 1.8^{mm} in length and was .4^{mm} in breadth at the front end, .62^{mm} at the middle, and .5^{mm} at the posterior end. The ovaries are roundish, somewhat reniform bodies at the posterior end of the segment, lying one on each side of the median line. They are about .36^{mm} in length and .24^{mm} in breadth.

The cirrus, which appears to be smooth, was retracted in all cases. Its bulb is pyriform, at right angles to the axis of the segment, the larger end within. It is .26^{mm} long and .16^{mm} broad at widest part. The vagina was traced in a gently sinuous course along the median line from the posterior end of the segment, at a point between the ovaries, to the cirrus bulb. It bends around the base and anterior side

of the bulb and opens in front of and beside the opening of the cirrus in a common marginal cloaca. The remainder of the interior of the segment was filled with roundish or oval bodies about .025mm in diameter. These are probably the spermatic capsules of the testis.

In looking over an unassorted lot of entozoa from the shark which was examined July 25, I found sixteen additional specimens of this *Anthobothrium*. These present the greatest variety of shapes and furnish examples of most of the forms already noticed, with many intermediate forms. The neck, however, in most of them, was moderately elongated. Two specimens were noted with excessively attenuated necks, the bothria directed forward with their faces appressed.

These additional specimens confirm me in the opinion that the diverse forms comprised in these three lots are specifically identical, the differences being due, mainly, to different degrees and conditions of contraction; while some of the differences are of such regular and constant occurrence as to deserve to rank as varieties, or at least peculiarities of form, which are liable to occur in the preserved specimens.

8. *Anthobothrium pulvinatum* sp. nov.

(*Pulvinus*, a cushion.)

[Plate IV, Figs. 4–9. Plate V, Figs. 1, 2.]

I was at first misled by the appearance of the bothria of this species, which, in the specimens that I had examined when the following description was written, were uniformly convex and corrugated, and that, too, in both the living and the alcoholic specimens.

The specimens were therefore referred to a new genus, *Rhodobothrium*, so named because of the rosette-like appearance of the bothria. It would be unnecessary to mention this change in nomenclature were it not for the fact that I used the name *Rhodobothrium* in a communication to the American Journal of Science and Arts, March, 1889.

I take advantage of an opportunity offered during the progress of publication to note that the bothria of this species may assume a quite different appearance from that which is represented in the figures in this paper. In some cases the muscular ring which surrounds each bothrium contracts to such a degree that the bothrium, together with its pedicel, becomes vase-shaped or even globular. The convex, corrugated surface of the bothrium is, in such cases, retracted, and the bothrium is terminated by a simple orifice or elongated into a papillary termination with the small orifice at its apex. When the bothria are thus contracted the resemblance to Van Beneden's figures of *A. giganteum* (Mem. Vers. Intest., Plate VII, 5–10) is very striking.

The disposition of the genital organs in the mature proglottides is different from that in *E. giganteum*, and the cirrus is echinate instead of smooth.

The specific name *pulvinatum* is retained as descriptive of a common, even if in a measure accidental, condition of the bothria.

Head cruciform, bothria four, directed forwards. The pedicels of the bothria are short, stout, and conical, bearing on their distal extremity the cushion-like bothria which are nearly circular in living specimens, or shaped like the quadrant of a circle in alcoholic specimens. The margins of the bothria are entire at the base, while their upper edges are frilled or ruffled and their faces thrown into corrugated folds. The bothria do not bear any supplemental disks, and there is no terminal papilla or myzorhynchus to the head. Properly speaking, there is no head, the four pedicels simply originate from the anterior end of the body like so many forks. That is, the neck is abruptly quadrivaricate at its anterior end.

The neck is long, flattened, somewhat enlarged, both in breadth and thickness near the head. It is crossed by fine transverse lines which gradually become more distinct and later divide the body into segments.

The body is long and of approximately the same breadth throughout or, in alcoholic specimens, somewhat thickened medianally. The first segments are very short and crowded, increasing uniformly in length; median segments widest, broader than long; first mature segments squarish, then a little longer than broad. Mature segments narrow in anterior diameter, broad behind, at length easily detached. Free proglottides somewhat elongated. All distinct segments with posterior diameter greater than anterior. Genital apertures marginal; male and female approximate near middle of margin. Cirrus very long and echinate.

Length of specimen 550^{mm}, accompanied with great numbers of free proglottides.

Habitat.—Trygon centrura, spiral valve; one specimen, with numerous free segments. Wood's Holl, Massachusetts, August 1, 1887.

The specimen which furnished the data for the foregoing description was very much larger than any of the associated species of Entozoa, of which there were several. The length while living was 550^{mm}, and there were besides, immense numbers of free proglottides, which must have come from this strobile, as it was the only one of the kind found, and most careful and painstaking search was made for small forms. Only a small proportion of the whole number of these free proglottides with which the chyle was swarming was saved. Upon counting the number, however, I find that there are about two hundred of them.

My notes made at the time of collecting contain this description of the head: Seen from the under side, each of the four bothria rises from a short, smooth, conical pedicel, which enlarges rapidly toward the distal end. The outer half of the length is made by the frilled and puffed margin of the cushion-like bothrium, which at first projects abruptly about midway from the base of the pedicel to the outer surface of the

bothrium and beyond the middle point is thrown into numerous small folds (Plate IV, Fig. 5). In front view, the bothria look like a cluster of white rosettes with contiguous edges in contact, and thus leaving a four-sided central space. There is no indication of a terminal papilla to the head or supplemental disc on the bothria. In the alcoholic specimen the outline of the bothria has changed from nearly circular to that of a sector of a circle. This is caused by the flattening of the sides of the bothria, which touch each other.

Although the specimen was rather active when first placed in sea-water, it showed little tendency to change either the shape or the relative position of the bothria. After it had lain in sea-water for twenty-four hours it still exhibited moderate activity. The bothria were then found to be 3^{mm} in length, measured from the base of the pedicel to the outer margin of the convoluted face, when the head was inclined forward so as to lie nearly on the faces of the bothria.

The resemblance of the head of this worm to a head of cauliflower is very striking. This simile has been employed by Van Beneden also in his description of *Phyllobothrium lactuca.*

The living specimen had the following dimensions: Length, 550^{mm}; diameter of head across the top, 4.5^{mm}; diameter of neck near the head, 1.6^{mm}; thickness of neck, 1.1^{mm}; length of last segment, 2^{mm}; breadth of last segment at anterior end, 1^{mm}; at posterior end, 2^{mm}. The spiral intestine contained enormous numbers of free proglottides which were about 4.5^{mm} long and 3^{mm} broad.

In the alcoholic specimen the breadth of head across the top is about 4^{mm}; diameter of a single bothrium 2.4^{mm}; diameter of pedicel at base, 1.1^{mm}, near bothrium 1.4^{mm}; length of pedicel and bothrium 1.6^{mm}.

Immediately behind the head the neck is a little wider and much thicker than it is one or two millimeters farther back. Fine transverse lines are visible almost immediately back of the head, but distinct segments do not appear until about 25^{mm} back of the head. The transition from fine transverse lines to the sharp division into segments is so gradual, that the first distinct segments can be located only for a limit of four or five millimeters. At the distance of 60^{mm} from the head the segments average 2^{mm} in breadth and about .03^{mm} in length. At this point the segments are broader on the posterior edge than the anterior. The posterior corners are therefore slightly salient and sharply and clearly cut. For the last 200^{mm} the segments appear to be mature. They did not, however, separate easily. They have a rounded or parabolic outline in front and are quite distinct from each other. The transverse line, which marks the division between two segments, is much shorter than the base of the segments. The mature segments are uniform in size, and symmetrical. The cirrus was extended in many of the posterior segments as much as .9^{mm}, with a diameter at base of from .1 to .16^{mm} and at apex of .08^{mm}. In the alcoholic specimen some of the cirri are extended farther than they were observed to be in life.

Many were from 1 to 2^{mm} in length, and one very slender one 3^{mm}. The cirri are provided with short, sharp-pointed, broad-based, recurved spines. Their length is about .005^{mm}. They are inserted on an epidermal investment of the cirrus, which is easily detached.

Some of the vessels of the water vascular system can be seen when the specimen is made transparent in glycerine or oil of cloves. Two large spiral vessels were seen in the neck near the head. A short distance back of the head they appear to lose their spiral character. In the head they divide and send branches through the pedicels to the bothria.

Anatomy of mature segments.—Fascicles of longitudinal muscle fibers were observed in sections of mature segments. These, which were stained deeply with carmine, differ from the longitudinal muscles which I have thus far observed in the Cestods in being distinctly and abundantly nucleated. The fascicles, indeed, appear to be made up principally of small fusiform muscle cells, which are about .0014^{mm} broad and .0055^{mm} long. The fascicles themselves vary in breadth from .005 to .014^{mm}, with varying intervals between approximating the breadth of the fascicles. The intervals between the fascicles are filled with granular tissue. Outside the fascicular layer and outside of this again is a layer which contains fine transverse, circular, and longitudinal fibers. The circular fibers lie outside the longitudinal fibers.

In the free segments the ovaries are seen as large lobed organs lying symmetrically on each side of the median line. The middle of the segments is crowded with ova. Near the margins, on each side, are the granular masses of the testes, while near the anterior end is a large convoluted tubular mass, made up, for the most part, of the voluminous vas deferens. The cirrus is of extraordinary length and quite slender. When retracted, the sheath extends into the interior of the segment, its base lying close to the posterior folds of the vas deferens. The latter in section is seen to be packed with exceedingly fine fibrous material, which appearance I take to be due to the presence of spermatozoa.

The course of the vagina was not satisfactorily traced throughout its entire extent. Its external opening is immediately in front of the cirrus, there being, in fact, but a single external opening for the genital organs. It lies close beside the front edge of the cirrus sheath. At the base of the latter it changes its course from one at right angles to the axis of the segment and is inclined gently towards the front end of the segment. I have not yet succeeded in tracing it in a continuous line to the ovary, but in several sections the vaginal tube was seen both near its outlet and in the midst of the lobes of the ovary. It seemed to disappear in the vicinity of the vas deferens. As only mature segments were cut into sections, it seems probable that the tissues of the vagina had already been absorbed to a considerable extent in its middle course, in order to give room for the ova, which are not confined to a definite uterus, but appear to fill the whole inner cavity of the segment.

The vagina near its beginning is tubular, but near the base of the cirrus sheath it is thrown into short, crisp folds, so that the walls in section appear frilled or ruffled.

The ovaries in section when highly magnified are seen to be made up of what appear to have been originally spherical bodies, but which on account of mutual pressure have become somewhat polyhedral. They measure from .008 to .01^{mm} in diameter. The free segments contain a few ova. These are oval in shape and had a smooth thin transparent shell, measuring .028 and .036^{mm} respectively in the two diameters. The shell incloses a granular mass which measures .014 and .019^{mm} in its two diameters.

Associated with the ova were some spherical granular masses .028^{mm} in diameter.

Upon examining a lot of small specimens from the same host that yielded the large specimen I find an exceedingly small individual which I shall, for the present, refer to this species. Its dimensions, from the alcoholic specimen, are the following: Length, 4^{mm}; diameter of head across top, .52^{mm}; diameter of single bothrium, .32^{mm}; length of bothrium with pedicel, .18^{mm}; diameter of pedicel, .12^{mm}; diameter of neck, .10^{mm}, swelling immediately to .16^{mm}; distance from head to first segments, .4^{mm}; length of first segments, .04^{mm}; breadth, .14^{mm}; length of last segment, .32^{mm}; breadth, .18^{mm}.

There are about twenty-three segments in all. It agrees with the larger specimen in the general appearance of the head, the disposition and outlines of the bothria and pedicels, although the faces of the bothria are not so distinctly convoluted. It differs in having a slight constriction back of head, and in the character of the segments, which instead of being short and crowded at first, soon become square, and before the middle of the strobile is reached, are a little longer than broad.

Since writing the foregoing description I have received from Dr. E. A. Andrews, of Johns Hopkins University, a single specimen, which I refer to this species. It was found in the spiral valve of a sting ray at Beaufort, North Carolina, August 8, 1885. The specimen has no mature segments. One bothrium is missing; the stump of its pedicel remains, however, to show the position of the bothrium. It differs from my specimen principally in its smaller size, in the relatively finer convolutions on the faces of the bothria, and the cylindrical, instead of conical, pedicels.

The length is 35^{mm}; diameter of head across the top, 2.48^{mm}; diameter of single bothrium, 1.25^{mm}; length of bothrium with pedicel, .9^{mm}; diameter of pedicel, .48^{mm}; diameter of neck, .68^{mm}. The segments are all very short and crowded, their length at posterior end of strobile being about .12^{mm}, and their breadth 1^{mm}.

The head of this specimen was stained with carmine and cut into transverse sections. The first sections show that the fine convolutions

which cover the bothria are composed of dense granular tissue. The convolutions in this specimen are rather narrow, measuring .014^{mm} in diameter. The sections very soon reveal the presence of what appear to be strong longitudinal fibers, their cut ends measuring as much as .006^{mm} in diameter. A little deeper and sections of large aquiferous vessels appear in each lobe, and the large muscular fibers become indistinctly fascicled. The irregularly sinuous aquiferous vessels traverse the bothria and unite in each pedicel into large vessels which lie so close together as to resemble a double tube. These evidently represent the afferent and the efferent vessel of each bothrium. A branch of this system near the face of a bothrium, in close vicinity to the convolutions, measured .027 and .022^{mm} in its two diameters; in the pedicel they were .032^{mm} in diameter.

Near the base of each pedicel and lying near the aquiferous vessels there is what appears to be a nervous mass from which branches ramify to the convolutions of the bothria. These branches, as well as the mass from which they originate, are sharply differentiated from the surrounding tissue, are neither tubular nor striated, but uniformly and finely granular. (Plate v, Fig. 1.)

The first sections to pass through the head are cruciform in outline. It is here seen that many of the large muscles seen in the first sections and supposed to be longitudinal are really transverse. Two fascicles of these muscles from each pedicel cross the head, are continuous with those of the opposite pedicel and at right angles to those belonging to the adjacent pedicels, thus forming a square in the center of the section. The inside of this square is filled with fine granular tissues. Following these sections are others which show fascicles of muscles passing from the base of one pedicel into the adjacent pedicels through whose tissues they ramify. These fascicles make a decussation in each axilla. Outside of each decussation there is a bundle of coarse longitudinal fibers in each axilla.

Two of the sections through the center of the head have a large central space filled with fine granular tissues from which branches proceed into each pedicel. I take this to represent the cephalic nervous system. A section which passes through the base of the head has a large rectangular central space .32^{mm} long and .24^{mm} broad, surrounded and limited by a layer of fine circular fibers and containing the large aquiferous vessels which here lie in loose coils. The remainder of the body wall outside the layer of circular fibers is composed of a layer of longitudinal fascicles of muscles which extends to the cuticular layer. This section passes a short distance into the pedicels which are here composed of large muscular fibers from the outer layer of longitudinal muscles. A few sections farther back the central space which contains the coils of aquiferous vessels is more nearly square. Plate iv, Fig. 8. The surrounding layer of circular tissue sends out numerous branches which ramify through the surrounding layer of longitudinal fibers forming a

loose spongy layer of tranverse tissues in the interstices of which the longitudinal fibers lie. The anastomosing branches of this spongy or irregularly reticulated layer unite again at the surface in a rather thick cuticular layer of circular fibers. A few sections further on the following dimensions occur: central space .3^{mm} long and .16^{mm} wide; thickness of circular layer .009^{mm}; thickness of reticulated layer .06^{mm}; thickness of cuticular layer .014^{mm}. The aquiferous vessels are here not so much folded. The central space contained the cross section of one pair and the longitudinal section of a coil of the other pair. The remainder of the central space contained some loose areolar tissue. The inner space grows narrower very rapidly as sections proceed from the head, and is speedily reduced to a narrow oblong space or core, enlarging slightly towards the margin, and containing a pair of aquiferous vessels near each extremity. Each pair of vessels consists of a larger and a smaller vessel, lying side by side, the larger one towards the center of the segment. Between the outer aquiferous vessel and the margin there is a smaller vessel without distinct outline. These two marginal granular vessels or cords can be traced from the cephalic granular mass. At the base of the head they lie on opposite sides of the rectangular central space and outside the layer of circular fibers. The diameter of one of the larger vessels was .045^{mm}; diameter of smaller vessel .032^{mm}; diameter of nervous vessel .022^{mm}; length of inner core .45^{mm}; breadth of section of inner core at middle .022^{mm}; thickness of section .4^{mm}; breadth of section .6^{mm}. The narrow core within its limiting layer of circular fibers is composed of granular tissue, and is at this point reduced to a very slender line. As the sections proceed the layer of circular fibers which surrounds the central core becomes thinner and in the last sections made, about 1^{mm} back of the head, had become almost entirely dissipated, so that the layer of reticulated or anastomosing tissue extended from the cuticular layer to the granular core.*

Echeneibothrium Van Beneden.

The characters of this genus, according to Diesing, are:

Body elongated articulate. Head continuous with the body or separated by a neck with a terminal retractile myzorhynchus. Bothria four, opposite, transversely costato-plicate, sometimes provided with longitudinal partitions, attached by the posterior margin to the head by means of a contractile pedicel, versatile, unarmed. *Os* in apex of myzorhynchus. Genital apertures marginal.

I have separated those species which have the characteristic echeneiform bothria, but are destitute of a myzorhynchus, from the genus *Echeneibothrium* and have placed them in a new genus *Rhinebothrium*.

* Dr. J. Niemiec, "Untersuchungen über das Nervensystem der Cestoden," in Arbeiten aus dem Zoolog. Institute zu Wien, T. VII, pp. 1–60, Taf. 1 u. 2, 1888, describes the nervous system of *Anthobothrium musteli*. It bears a close resemblance to that which I have made out in *A. pulvinatum*.

9. *Echeneibothrium variabile* Van Beneden.

[See Report of U. S. Commissioner of Fish and Fisheries for 1886, pp. 460–462, Plate I, Figs. 9–13, for description and synonymy.]

I have already noted the occurrence of this parasite in the common skate (*Raia erinacea*). Since the description which is referred to above was published, I have found this *Echeneibothrium* on two different occasions. On August 29, 1887, I examined twenty-four skates. Their stomachs were filled with small crustacea, for the most part *Crangon vulgaris*. Some of them contained, beside these, a few Annelids, such as *Nereis* and *Rhynchobolus*. Many of the skates had no parasites. About a half a dozen specimens of *E. variabile* and one specimen of *Rhynchobothrium erinaceus* were obtained from the spiral valve and a few *Nematods* from the stomach and spiral valve of a few. On September 6, 1887, I examined ten skates and obtained from the lot four specimens of *E. variabile*.

I add the following data, based for the most part on notes made while observing the living worms.

The following measurements are from one of the living specimens of the first lot: Length 55^{mm}; length of bothrium, including pedicel, varying with contraction from .5 to 1^{mm}; diameters of face of bothrium .24^{mm} and .6^{mm}; diameter of myzorhynchus at base about .26^{mm}, length .08^{mm}; diameter of neck .14^{mm}; distance to first segment 1.4^{mm}; length of first segment .025^{mm}, breadth .16^{mm}; length of median segments .3^{mm}, breadth .22^{mm}; length of last segment 1.26^{mm}, breadth .42^{mm}.

The segments were transversely rugose. The head was opaque, ivory white; central core of neck also dense, opaque, white for .4^{mm} back of head. When placed in Perenyi's fluid this specimen shrunk to 30^{mm}. Another specimen in the second lot was first placed in fresh water, then transferred to alcohol; it measures as an alcoholic specimen 44^{mm}. It was not measured while living, but it did not shrink so much as the specimen which was killed in Perenyi's fluid.

It is very difficult to ascertain the exact number of the loculi on the face of a single bothrium. The plan of arrangement, however, seems to be as follows: Three transverse costæ and a middle partition divide the face of each bothrium into about eight loculi. Of these, three pairs are median and two single loculi are terminal. The bothria, although undoubtedly capable of expanding broadly, have a tendency to contract and close up by the appression of the sides and ends, and this too when first placed in sea-water. Some of the specimens are so much contracted as almost entirely to conceal the bothrial cortæ. None of the specimens in these lots showed the posterior elongation of the head noted and figured in my former paper. One specimen, measuring 27^{mm} in length, was not so active as the others; moreover no loculi could be discerned, although the general appearance of the head was the same as that of the others. The last segments, which were about .6^{mm} long and .4^{mm}

broad, were convex on the margins and bluntly rounded at the ends. Another specimen, 10^{mm} in length, had a very irregular outline, the neck greatly enlarged and the segments much shortened by contraction. A fragment, 13^{mm} in length, although without a head, exhibited a decidedly progressive motion. The segments were in a state of activity; their proportions of length and breadth changing rapidly. Some of the segments of this fragment, when stretched out, had the shape of an elongated parallelogram. One, while in this position, measured .4^{mm} in length and .16^{mm} in breadth; when contracted it was nearly square, with convex margins, and measured .3^{mm} in length and .26^{mm} in breadth.

A small specimen, 6^{mm} in length, presents some anomalies. The bothria are small as compared with the myzorhynchus. The latter is elongated, conical, smaller at apex than base.

When one of the normal scolices was compressed the bothria contracted, and, so to speak, were absorbed in the head. The head was rather swollen and globular, while the faces of the bothria, on the side of the globular head, resembled the sucking disks of *Tænia*.

When pressure was relieved the bothria were protracted again on elongated pedicels, and became very variable in shape and size. When the bothria were thus extended the head proper was much reduced in size, and the pedicel of the bothria gave it a cruciform shape.

The myzorhynchus was not observed to change its shape much, but it is evidently capable of changing its form. There is a terminal *os* which leads to an inclosed globular proboscis. It is probable that this organ is susceptible of great variation in form, but I have never observed it exhibit any other change than that which was incident to greater or less protrusion.

One peculiarity, which appears to be characteristic of this worm, is the cylindrical form of the anterior part of the body. The neck, or jointless part of the body, is cylindrical, as are also the anterior and median segments. The mature segments are also quite plump, but often irregular in outline. In all the specimens which furnished material for these data, the segments, with the exception of a few mature ones, are exceedingly regular. The margins are parallel, and the posterior edges project little, if any, so that the strobile for its anterior and median portions has an almost entire outline. The cirrus, although not protruded in any case that was brought under observation, was plainly seen as it lay coiled up in its bulb. It is slender and echinate throughout its entire length.

Olsson figures *E. variabile*, with a rosette-like myzorhynchus, a feature that I have never observed in any of my specimens. These specimens which I have referred to *E. variabile* are also much like *E. affine* of Olsson. I have not yet had an opportunity to examine type specimens of European species. Upon comparison with type species this form may prove to be specifically different from any of the closely related European species.

RHINEBOTHRIUM gen. nov.

[Ῥίνη, a rasp.]

Body articulate. Head continuous with the body or separated by a neck. Neck merging into segmented body or separated by a constriction. Bothria four opposite or in lateral or marginal pairs, faces divided into loculi by several or many transverse and one or few longitudinal muscular partitions, mounted on slender pedicels, very versatile, unarmed, myzorhynchus none.

Genital apertures marginal.

The genus *Rhinebothrium* is established to accommodate species with echeneiform bothria, but which have no terminal proboscis of any kind. The presence or absence of such a complicated organ as the myzorhynchus of *Echencibothrium* appears to one to indicate a generic difference. If this view is correct, then species like Van Beneden's *Echeneibothrium minimum* should be referred to the genus *Rhinebothrium*.

10. *Rhinebothruim flexile* sp. nov.

[Plate v. Figs. 3–5.]

Bothria four, opposite, long, slender, versatile, attached at middle point to head by moderately short pedicels. Face of each bothrium with numerous loculi in two longitudinal rows, forty, more or less, in each row. The slender, free ends of the bothria very versatile, bending readily in any direction, but especially in the plane of the supporting pedicel and axis of the body. An apparent hinge in middle of face of each bothrium opposite the pedicel. No head, strictly speaking, except what is formed by the bothria and their pedicels. Myzorhynchus none. Neck short, cylindrical, merging imperceptible into the body. Segments begin near the head. First distinct segment broader than long, very soon becoming squarish, then longer than broad; mature segments six or eight times as long as broad, subcylindical or fusiform, narrowed at the extremities.

Genital apertures marginal, about middle of segment; cirrus echinate.

Maximum length 16^{mm}; length of posterior segments from 1 to 1.6^{mm}, breadth .2 to .32^{mm}.

Habitat.—*Trygon centrura*, spiral valve, twenty-five specimens, Wood's Holl, Massachusetts, August 10, 1887.

This species possesses some characteristic features which ally it with Van Beneden's *E. minimum* from *Trygon pastinaca*. This is especially true in respect to the shape of the mature segments and the entire strobile, in fact, excepting the bothria. The differences shown by the latter, however, are too profound to allow them to be referred to the same genus. This difference can be readily appreciated when it is remembered that *E. minimum* is characterized by having the bothria crossed by eight to ten transverse septæ, while *R. flexile* has in the neighborhood of forty.

I found some difficulty in ascertaining the exact number of costæ and resulting loculi, on account of a tendency on the part of the bothria to curl up at the free ends. The arrangement of the costæ is as follows: A thick double muscular band traverses the middle of the face of each bothrium from tip to tip, like the keel plank in the frame-work of a skiff. From this middle partition numerous ribs rise, curving outward and upward to unite in a thick crenulated rim, which forms the border of the bothrium. To carry out the figure of the skeleton of a skiff, the curving costæ answer to the ribs, and the thick crenulated rim to the gunwale. The costæ are arranged with perfect symmetry on the two sides. I am not yet certain as to the exact number of these costæ, nor am I certain that the number is precisely the same in every individual. I have counted as many as were in view and estimated the number in concealed and obscure parts with varying results, viz, from thirty-two to forty and upwards on a side, thus making, in round numbers, from sixty to eighty loculi on the face of each bothrium. The bothria have a tendency to bend abruptly at the middle on a transverse hinge-like line. The margins of the bothria are usually slightly notched at the extremities of the hinge. The head of the living worm is almost transparent and the bothria are exceedingly active. On account of their transparency and gracefully curving outlines they are very beautiful objects. The pedicels were not observed to contract or lengthen appreciably, and in the preserved specimens they have changed their proportions but slightly from what they were in life. In the alcoholic specimens the pedicels have about the same diameter as the neck, or a little greater, and their length does not quite equal their diameter. They appear to be arranged cruciformly. The bothria in the alcoholic specimens are variously bent. In some their free ends are turned towards the axis of the body and so curled up as to give the head an almost globular outline. In others the bothria are turned in the opposite direction. The pedicels, as to their origin, are like so many forks branching abruptly from the apex of the neck, and the bothria are like a terminal whorl of four petiolulate leaflets at the summit of the petiole of a compound leaf. There is, therefore, scarcely anything that can be called a head, if the bothria and their pedicels are disregarded. The short, cylindrical neck is, in some cases, slightly enlarged a short distance back of the head.

In five specimens of the lot of about twenty-five there was a small red spot in the center of the neck near the base of the pedicels. There do not seem to be any correlated features to distinguish these specimens with the red spot in the neck from the others in which no red spot is visible.

The two sorts were placed in different vials at the time of collecting, but the red coloring matter is dissolved out by the alcohol, so that when I came to study this species after they had been preserved for some months, there is nothing but the label on the vials to tell that there was ever any difference between the two lots.

The neck is crossed with fine transverse lines which, in less than a millimeter back of the head, outline the first segments. These for a short distance are very short but increase in length rapidly. In an alcoholic specimen, at the distance of 1.4^{mm} from the head, the segments are as long as broad; at a distance of 3^{mm} they are a little over twice as long as broad; about the middle of the strobile their length is five times their breadth; the last segment is seven times as long as its greatest breadth; the entire specimen measured 14^{mm} and the last segment 1.4^{mm} in length.

The breadth of the body remains nearly uniform throughout. The posterior segments are usually rather narrow at the two extremities and swollen in the middle in the vicinity of the reproductive aperture. The dimensions of one mature segment, somewhat flattened, are: diameter near anterior end .16^{mm}; diameter in front, at junction with preceding segment, .1^{mm}; diameter at middle .22^{mm}; diameter near posterior end .12^{mm}; diameter at junction with succeeding segment .08^{mm}.

When mature segments are placed in glycerine and studied with a low magnifying power, the ovaries may be seen as two long, somewhat opaque bodies, lying at the posterior end of the segment, one on each side of a transparent median space and extending nearly to the middle of the segment.

The reproductive aperture is marginal, about the middle of the segment. The cirrus was retracted in all the specimens, but it could be seen, together with the *vas deferens*, lying in a coil in the middle of the segment. Several large ova were observed lying loosely along the median line, from the anterior end of the segment back to the front end of the ovaries. These ova vary greatly in size and shape. They appear to be quite large in proportion to the size of the segment, and are, moreover, comparatively few. Measurements of average ova yielded the following results: .017 by .011^{mm}; .019 by .01^{mm}; .022 by .011^{mm}; .017 by .013^{mm}. An elongated ovum measured .05 by .011^{mm}; another .047 by .014^{mm}; a pear-shaped one was .03^{mm} long, .014^{mm} in its greatest breadth, and .008^{mm} in its least breadth.

The following measurements were obtained from living specimens:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length	7.50	13.50	16.00	15.00
Breadth of head	.80	.60	.80	.....
Length of bothrium	.60	.80	.....	.80
Breadth of bothrium	.10	.20	.....	.....
Breadth of neck	.09	.10	.24	.10
Distance to first segment	.40	.50	.60	.60
Length of first distinct segment	.05	.03	.04	.04
Breadth of first distinct segment	.10	.16	.26	.10
Length of last segment	.20	1.04	1.40	1.60
Breadth of last segment	.20	.24	.34	.24
Number of distinct segments	21	34	40	35

Nos. 1 and 2 had the red pigment spot in the neck; Nos. 3 and 4 were without any red coloring matter in the neck; Nos. 1 and 3 were somewhat flattened under the compressor; Nos. 2 and 4 were not compressed; in No. 2 the neck immediately behind the bothria was slightly swollen and measured .2^{mm} in diameter, while beyond the swollen point its diameter was as given above; in the same specimen the fifth segment from the end was .88^{mm} in length; in No. 4 there were twelve mature segments. All the mature segments were thickest in the middle and tapered towards both ends.

The vessels of the water-vascular system are very distinct in the living specimens; they could be traced from the anterior part of the body, where they lie near the margins, through each pedicel to the bothria. Each pedicel contains two vessels, one of which communicates with one of the marginal vessels of the neck and the other is continuous with one of the vessels in the diagonally opposite pedicel; these vessels are all sinuous. Strong bands of longitudinal muscles run from the neck into the pedicels and to the bothria. As each of the numerous loculi acts as an independent cupping-disk, their combined action must enable the parasite to adhere with considerable power to the mucous membrane of its host. The cirrus, although retracted in every case, was seen in sections of a segment to be covered with spines; the cirrus appears to be slender and the spines are minute.

In size of strobile, shape of segments, size of ova and echinate cirrus, *R. flexile* agrees with Van Beneden's *E. minimum*. There was not a single individual in the lot of twenty-five specimens, however, whose bothria agree with *E. minimum*.

11. *Rhinebothrium cancellatum* sp. nov.

[*Cancellatus*, latticed.]

[Plate v, Figs. 6–8.]

Head with four lateral bothria, which are elliptical and mounted on short pedicels; faces of bothria with about twenty-one loculi arranged somewhat trilineally; anterior margins of bothria free, slightly projecting, posterior margins appressed, neck broad and flat at base of bothria, somewhat constricted behind head, and almost immediately crossed by fine, closely-crowded, transverse lines; distinct segments make their appearance 1^{mm} or less back of head; the segments are much broader than long throughout the length of the strobile until near the posterior end, where they are as long or even longer than broad; they are convex on the margins, so that the marginal outline of the strobile is crenulate; the chain of posterior segments is rather moniliform; the anterior and median parts of the body are crossed at more or less regular intervals by distinct transverse lines, which give rise to the deceptive appearance of elongated transversely wrinkled bothria; body rather flat and thin;

length, 25mm; breadth, 1 to 1.5mm; genital apertures marginal; cirrus echinate.

Habitat.—Rhinoptera quadriloba; spiral valve; three specimens; Wood's Holl, Massachusetts, July 20, 1887.

The three specimens which furnish the data for the present description were found in the posterior fold of the spiral valve of the cow-nosed ray (*Rhinoptera quadriloba*).

When first placed in sea-water they were rather active. The extended bothria gave the head somewhat the appearance of a peltate leaf. The face of each bothrium is divided into twenty-one pits or loculi. The arrangement of these loculi in every case in the living specimens appeared to be definite and the number constant. There is first a longitudinal row of five comparatively large loculi, occupying the middle line of the bothrium; then a small pit at each end, and seven pits on each side, making twenty-one in all. The loculi are larger towards the posterior end of the bothria than they are in front. In alcoholic specimens the edges of the bothria are curled inwards so that it is not always easy to count the exact number of loculi. The characteristic appearance of a circle of about sixteen loculi around the circumference of the bothrium and a longitudinal row of five at the bottom of the face of the bothrium can be made out in most cases. In one of the specimens, when cleared up in oil of cloves, there appeared to be eighteen loculi around the border, which, together with the five central ones, would make twenty-three instead of twenty-one. From this circumstance I am therefore as yet in some doubt as to whether the number of loculi is always constant. The ribs which outline the loculi are thick and muscular and give to the margins of the bothria a crenulate outline. The pedicels are very short and thick. The bothria are lateral, their posterior ends rather thick and slightly flaring. In consequence of this the head of alcoholic specimens is sagittate in marginal, squarish in lateral view. In the living worm, when at rest, the bothria are elliptical.

The first segments begin as fine transverse wrinkles. In one specimen the first distinct segments began about 1mm back of the head and were .03mm long and .4mm broad. What appears to be a characteristic of the species is the occurrence at short intervals of very distinct transverse lines which divide the body into pseudo segments. These upon superficial examination might be mistaken for true segments. When examined carefully, however, they are seen to be made up in each case of a number of true segments. In one specimen the first of these transverse lines appeared 3.2mm back of the head, the next 3.8mm, and following this two others 5 and 7mm, respectively, from the head. These pseudo-segments are formed in some cases by the natural division between two segments becoming very distinct, in others by an entire segment becoming thin and transparent.

Following are the measurements, in millimeters, of a living specimen:

Length, 25.55; length of bothrium at rest, .7; breadth, .53; breadth of head, 1.23; breadth of first segments, about 1 back of head, 4; length, 03; breadth of median segments, .72; length, .15; average length of posterior segments, .13; breadth, .8.

In the above specimen there was a constriction behind the head .28^{mm} in diameter, while immediately behind the constriction the neck was .46^{mm} in diameter. Near the posterior end of the strobile there was an enlargement due to contraction, which was 1.1^{mm} in diameter. In another specimen, 20^{mm} in length, the first segment began less than 1^{mm} from the head, where they were .8^{mm} broad and .05^{mm} long. The median segments were 1.4^{mm} broad and .1^{mm} long. The posterior segments were narrower, breadth, .44^{mm}, length, .46^{mm}, with rounded angles, the strobile here being somewhat moniliform.

The vessels of the water-vascular system were quite evident in the living specimens, both in the body and the bothria. One set of longitudinal vessels, consisting of a single vessel near each margin, was peculiar in that each vessel was quite irregular, swelling out into suboval enlargements and giving off short lateral branches at intervals. These may be nervous vessels.

When the specimens were placed in alcohol the longest of the three contracted until it was shorter than the others.

Anatomy of the segments and bothria.—A few of the posterior segments of one specimen were stained with carmine and cut into longitudinal sections. The segments all proved to be immature, and consequently only a comparatively few points in their anatomy could be made out.

The outer coat of the muscular wall is composed of two layers of finely fibrous tissue, an outer layer of circular, and an inner of longitudinal fibers. In sections these two sorts cross each other at right angles, forming a net-work with rectangular meshes. Beneath the outer fibrous layers is a thick layer of densely granular tissue. The granules stain deeply with carmine, and are from .003 to .006^{mm} in diameter. Beneath the granular layer is a layer of longitudinal muscle fibers. These are larger than the fibers in the outer longitudinal layer, and are arranged in straight, parallel fascicles, which are from .0025 to .005^{mm} broad and .0025^{mm} apart.

The most prominent organ in these segments is the cirrus and its sheath. In all cases the former was retracted. The external opening of the cirrus is at the margin near the anterior edge of the segment. The sheath, with the inverted cirrus, extends a little past the middle line of the segment. The cirrus when extruded must be therefore relatively quite long. The sheath enlarges towards the center of the segment, where its diameter nearly equals the length of the segment. The length of one was .28^{mm}; its diameter at base .027^{mm}. The cirrus throughout all its length is thickly beset with spines. The spines at the base are much longer and stouter than those along the middle and at the apex. Some of the basal spines were .008^{mm} in length, and .003^{mm}

broad at base. They are straight, with sharply recurved and hooked extremities.

I have not yet suceeeded in making out the other genital organs with entire certainty. The sections show near one of the lateral faces a number of irregular masses, which, from their striated appearance and absence of stained nuclei, I suspect to represent the convoluted vas deferens. Toward the interior of the segments these give place to irregular granular bodies from .02 to .04^{mm} in diameter, which fill the interior of the segment around the muscular cirrus sheath. These bodies evidently represent the spermatic capsules of the testes. I find no traces of even the beginning of female genitalia in these segments.

Transverse sections of the head show that the loculi are formed by a dense layer of parallel radiating fibers, which is very sharply defined from the deeper tissue of the bothria. This layer is about .05^{mm} thick at the bottoms of the loculi, but is somewhat thinner at the edges. It appears to consist of columnar epithelium. Where two loculi join, this layer of radiating fibers in each rises to form the separating costa. The transverse section of a costa therefore shows it to be composed of two layers which are confluent at the outer edge. This radiate fibrous tissue contains a few scattered granules, which, although very small, in several instances proved to be distinctly nucleated. The radiating fibers of the bothria themselves originate from a thin layer of fine fibers, which in many places seems to have separated from the tissue beneath, but which, in normal position, rests on a layer of coarse longitudinal fibers in the center of the bothria. Towards the edges of the bothria the coarse longitudinal fibers disappear and the layer of radiating fibers is succeeded by the outer granular tissue of the head, in which there are a good many longitudinal fibers.

Four principal vessels are cut by these cross-sections. Of these, two lie near the center of the head and are .015^{mm} and .02^{mm} in diameter, near the middle of the length of the head. The others are larger, oblong, and are situated near the margins. Near the middle of the head the inside diameters of one of the marginal tubes were .025 and .016^{mm}, the outside diameters .032 and .038^{mm}. These dimensions are somewhat exaggerated since the sections were carried a little obliquely through the head.

Transverse sections of the neck reveal the same alternation of muscular layers as noticed in the segment. The fascicles of the thick layer of longitudinal muscles are oblong in section and are disposed radially around the central space. This layer is interrupted for a short distance at the margins, where the granular central space is continuous with the granular layer, outside the fascicular layer.

In some sections there are three, in others there appear to be four, vessels near the margins. Two of these are larger than the others. The outer one of these two, that is, the one nearer the margin, has a definite limiting wall, while the other is more irregular in outline and

in places contains a fine granular substance. The latter vessel I take to represent the irregular longitudinal marginal vessel noticed in the living specimens, and which may be a nervous vessel.

In sections of the head the bottoms of the faces of a marginal pair of bothria lie very close together. The inner core of the head is thus very narrow, and composed mainly of coarse longitudinal fibers, with an inner granular core in which lie the aquiferous vessels. This species appears to be near *Echenebothrium tumidulum* Rudolphi.*

The published descriptions of *E. tumidulum*, however, agree, in the main, in saying that the first segments are extremely long and narrow, and that the bothria are divided into loculi by transverse costæ and a median partition.

The former of these differences might be reconciled by supposing that the pseudo-segments of *R. cancellatum* have been taken for true segments by former describers.

The difference between the bothria of *R. cancellatum* and *E. tumidulum* is too profound to admit of reconciliation. No median row of loculi is shown in any of the published figures of *E. tumidulum* that I have seen, while in *R. cancellatum* it is very evident and could not possibly be mistaken for a median partition.

12. *Rhinebothrium longicolle* sp. nov.

[Plate VI, Figs. 1–4.]

Bothria four, marginal, linear-oblong, attached at middle point by short pedicels, ends free, margins crenulate, faces boat-shaped, deeply concave from side to side or with edges appressed, divided into loculi by about twenty-four transverse costæ and a median partition, very versatile. Neck long, slender, smooth, cylindrical, rounded posteriorly and separated from the body by a constriction. Body behind constriction a little smaller than base of neck, at first cylindrical and crossed by minute transverse lines which soon give rise to distinct segments. Segments at first very short, increasing in length uniformly, near posterior end as long as broad with posterior edge very slightly overlapping succeeding segment. Posterior segment elongated or, if contracted, with very convex margins.

Genital apertures marginal, male and female approximate. Length, 28^{mm}; breadth, .6^{mm}.

Habitat.—Myliobatis freminvillei, spiral valve; two specimens. Wood's Holl, Massachusetts, August 5, 1887.

This description is based on two specimens from the spiral valve of the sharp-nosed ray (*Myliobatis freminvillei*). The stomach of the host was empty and there were no other parasites found.

* *Bothriocephalus tumidulus* Rud., *B. Echeneis* Leuckart, *Petalocephalus tumidulus* Van Lith de Jeude, *Tetrabothrium tumidulum* Rud. Dies, and *Echenebothrium tumidulum* Beneden, Dies.

Following are the measurements of a living specimen :

	Millimeters.
Length	28.00
Length of bothria	2.00
Breadth of bothria, middle	.20
Diameter of neck near head	.16
Diameter of neck at base	.32
Diameter of constriction between neck and body	.18
Length of neck	7.00
Length of first distinct segments	.03
Breadth of first distinct segments	.40
Length of median segments	.20
Breadth of median segments	.60
Length of posterior segments	1.00
Breadth of posterior segments	.40

Measurements of median and posterior segments were made with difficulty on account of the incessant and active movements of contraction and expansion of those parts. The bothria, likewise, were in constant motion and exact measurements of them could not be obtained. The measurements given above are, however, approximately correct. In the living worm in sea-water the bothria and pedicels are yellowish white, the neck and head between the bothria, bluish white, anterior segments yellowish white, remaining segments yellowish white at center with bluish white border along each margin. The bothria were exceedingly active and they changed their position constantly. The ends of the bothria being free and the whole organ turning easily on its pedicels as on a pivot, it is therefore possible for an infinite number of positions to be assumed. While the resting position of a bothrium is that in which its long axis is parallel with the axis of the body, it is occasionally thrown forward and turned so as to lie across the top of the head at right angles to the longitudinal axis of the head. The ends of the bothria sometimes turn towards each other, sometimes they are reflexed. These movements and the resulting positions are all exceedingly graceful. The diameter of a pedicel, although variable in life, is about, .36^{mm} and the thickness of a bothrium near the pedicel about the same, .36^{mm}. When one of the specimens was put in fresh water the bothria became arcuate, their ends being reflexed, while the margins of the boat-shaped faces were closely appressed. The epidermis of the body also became loosened and in places was detached.

In fresh water and in alcohol the head and neck contract but little while the body contracts very much. In the alcoholic specimens the ends of the bothria are flexed so that the head is nearly globular.

The long, cylindrical neck of the living worm, when viewed with transmitted light, was seen to be traversed by a dark central line and by many wavy or crinkled longitudinal fibers. When moderately magnified, the dark central line appeared to lie between two inclosing dark lines, as if in a tube. The neck, while very flexible and often changing its position, was not observed to contract or expand.

One of the specimens has a crenulated marginal outline to the pos-

terior part of the body on account of the convex margins of the segments. In the other specimen the margins of the segments are not convex. The latter specimen is not so long as the other and the posterior segments do not correspond in their degree of development.

The water vascular system was plainly visible in the living specimens as rather large sinuous vessels lying a little way from each margin.

The segments are rather thick and crossed by very fine transverse lines, so that the margins of the segments when sufficiently magnified are finely crenulate. The posterior end of the last segment in one of the specimens was concave and appeared to have a fluted border. These last two features are doubtless due to the superficial layer of circular and the deeper layer of longitudinal muscles. The body, from the constriction which separates it from the neck, to the posterior segments, was, in life, very contractile, and was constantly shortening and elongating itself.

The genital apertures are marginal and situated about the middle of the segment. The vagina opens immediately in front of the cirrus. The two organs have a common external cloaca. Ova were observed escaping from the middle of a margin of one segment and from the anterior edge of another, in a specimen which was somewhat flattened under a compressor. Each ovum consisted of a hyaline envelope inclosing a granular mass. The dimensions of these living ova are: diameter of outer hyaline envelope .0279^{mm}; diameter of inner granular part .0203^{mm}.

In the alcoholic specimens these ova have undergone considerable modification. The hyaline envelope has, in most cases, collapsed and adheres to the granular interior as a closely investing membrane. This investing membrane has in most cases a very irregular outline. It has the appearance of sending out radial prolongations which are often as long as the diameter of the granular mass. In a very few cases the hyaline envelope is but little contracted. The diameters of the ova, with collapsed investing membrane, vary from .008 to .014^{mm}. The greatest diameter of an ovum with an unbroken envelope was .022^{mm}, the diameter of its granular contents being .016^{mm}. The latter is deeply stained with carmine. These ova are not free but are in a loose cluster which is held together and attached to the segment by fine interlacing hair-like fibers.

The cirrus is long and slender, and, so far as observed, without spines.

Anatomy of posterior segments.—Thin sections were made of two segments from near the posterior end of one of the specimens. The cuticle at the margins had disappeared in some places, in others it still adhered and presented a brokenly serrate outline. Beneath the cuticular layer is a thin coat of fine muscular fibers, consisting of an outer layer of circular and an inner of longitudinal fibers. This is underlaid by a coarse granular layer, and this again by a layer of coarse longitudinal fibers. The latter present a very peculiar appearance. They are surrounded by granular tissue, while many of them are char-

acterized by successive enlargements, so as to have a decidedly moniliform outline. The segments from which these sections were made were constricted at the extremities and bulging in the middle. The longitudinal fibers conformed to this subspherical shape, being straight in the vicinity of the median line and curving towards the margins.

The cirrus in these sections is seen to be long and slender and to lie in many convolutions within a cylindrical sheath which extends at least to the middle of the segment. The center of the segment is filled with large, coarse granular masses, the spermatic capsules of the testis.

The ovary is a folded or crumpled glandular organ and lies near the posterior edge. In the middle of the ovary, in two of the sections, there was a circular body, like a rosette, which is probably the shell gland.

A convoluted sinuous tube extends from the ovary along the median line. It was traced nearly to the base of the cirrus sheath where it was lost. It is probably the vagina, which in living specimens was seen to open immediately in front of the cirrus, but which was not evident in these sections. These sections did not contain any ova. The specimen from which the sectioned segments were taken was evidently immature.

The mature segments are converted into mere cases for containing ova. Apparently all the tissue of the inner part of the segment, except that which contributes to the formation of ova, is converted into fine fibrous tissue which escapes from the ruptured segments along with the ova and serves to bind them together into loose clusters. Large convoluted masses of very fine fibrous tissue were abundant in the mature segments.

SPONGIOBOTHRIUM Linton.

Characters emended.—Body articulate, tæniæform. Head separated from body by neck. Bothria four, in lateral pairs, pediceled, with crisp-folded or auriculate edges, which are crenulate and the auriculate flaps finely costate on account of a marginal row of loculi with muscular borders; unarmed and without transverse costæ on face. No myzorhynchus, no supplemental disks. Genital apertures marginal.

The crisp-folded edges of the bothria produce an effect which suggests Leuckart's *Bothriocephalus flos* (*Anthobothrium auriculatum* var. *centifolium* Dies.) The costate flaps suggest relationship to *Rhinebothrium*.

The bothria are not opposite in the sense of being cruciformly arranged, as might be inferred from the original description, but are in lateral pairs, each being, in fact, the termination of an apparently immobile pedicel.

13. *Spongiobothrium variabile* Linton.

Report of U. S. Fish Commission for 1886, pp. 462-464, Plate II, figs. 13-19.

Specific characters emended.—Head broad, appressed. Bothria four pediceled, fan-shaped, in lateral pairs, their faces and margins with numerous frill-like lobes which are sometimes gathered into a more or

less compact mass of crisp folds, sometimes expanded into long, curved auriculate or leaf-like flaps. Borders of bothria with a row of small loculi which give a crenulate outline to margins and a costate appearance to the auriculate flaps. Behind the bothria the head is quadrato-pyramidal tapering posteriorly, prolonged anteriorly into the pedicels of the bothria. Neck short. First segments short and crowded, medium and posterior segment squarish or elongated, according to state of contraction. Free proglottides four to eight times as long as broad, with irregular outlines.

Genital apertures, male and female approximate, in a marginal depression about the posterior third. Maximum length 90^{mm}.

Habitat.—Trygon centrura, spiral valve, August, 1884, July 29, 1886; four specimens on each occasion. Wood's Holl, Massachusetts.

I append the following additional data obtained from a lot of specimens collected July 29, 1886.

The specimens in this lot measured, while living, 66, 74, 82, and 90^{mm} respectively. The bothria of all were finely frilled on the edges. The head of one of the specimen measured 2^{mm} in breadth and 1.15^{mm} in thickness. The free proglottides, which accompanied these specimens, were quite active and exceedingly changeable in form. Their usual shape was elongated with the anterior end contracted into a kind of knob. The greater number of these proglottides while they were yet in the water and active burst open on one of the lateral faces. From the lateral apertures thus formed, ova and a part of the genitalia were forced out. The latter remained protruding from the lateral aperture as an ivory-white, cotton-like mass. The cirrus, which was protruded in many cases, is very long and slender.

The living ova were comparatively large. Each one consisted of a transparent globular pellicle, within which were from three to five granular masses, which seemed to be nuclei undergoing normal development. The diameter of a single ovum was .18^{mm}. The diameter of a single granular mass .02^{mm}.

A re-examination of the mature segments with the aid of thin sections enables me to add the following data regarding the anatomy. The convoluted mass of tubes in the center of the posterior segments appears densely striated in a section stained with carmine. It is evidently the vas deferens crowded with spermatozoa. In the anterior part of the section there are numerous circular patches of granular and striated tissue. The large, globular granular masses which fill the anterior two-thirds of the median segments are evidently the spermatic capsules of the testes. The cirrus is long and densely covered with spines, which appear to be easily removed from the protruded organ. The spines at the base of the cirrus are relatively long, rather slender, nearly straight, slightly recurved at the slender point and have a short basal articulation. Length of spine at base of cirrus, in one case

.016^{mm}, with diameter at base .003^{mm}; in another case, length of spines .022^{mm}, length of basal part .002^{mm}, diameter .0027 to .0036^{mm}.

The vagina is a narrow, much convoluted tube which originates between the two lobes of the ovary, in the posterior part of the segment. It follows the median line to a point on a level with the cirrus bulb, where it turns abruptly towards the margin to open immediately in front of the cirrus. Immediately in front of the inner end of the cirrus bulb it enlarges suddenly into a vaginal sinus. This vaginal enlargement, in one section, was .2^{mm} in length and .04^{mm} wide at widest part. The beginning of the narrow part appears to be lined with minute bristles. A few loose spines of the cirrus were observed in the vaginal sinus. These may have been carried over from the base of the cirrus, which lies near by, by the knife, or they may have become detached from a cirrus during copulation before the specimen was killed.

In the free proglottides with ripe ova, there is a large oval aperture on one of the lateral faces for the escape of ova. One of these oval apertures measured .4 and .3^{mm} in its two diameters. In these ripe proglottides the ova fill up almost the entire interior. The proglottides are in fact converted into mere sacs containing ova. In the alcoholic specimens the ova are small, granular, with a thin, irregular, and collapsed investing membrane. The diameter of the granular part is .02^{mm}. The ovaries are elongated oval organs occupying the posterior third of the segment, extending from the posterior end of the segment almost to the cirrus bulb.

The costate appearance of some of the prolongations of the edges of the bothria, which was alluded to and figured in the original account of this species, was not properly understood when the original description was written. It is to be accounted for, I think, in this way: When the border of a bothrium is prolonged, the prolongation will, of course, be bordered by the marginal row of loculi. As a prolongation becomes narrower, it is at the expense of that part which lies within the marginal loculi. In very narrow prolongations the row of loculi on opposite sides of the prolongation become approximated on either side of a line which is made up of the inner edges of the two rows of loculi. Such a flap when flattened out looks something like a linear pinnate leaf with a prominent midrib.

In this lot of specimens, as in the lot which furnished the basis of my former description, there are two varieties. In one the anterior and median segments are uniformly broader than long, becoming squarish toward the posterior end, the margins of the strobile crenulate. In the other the segments soon become longer than broad, slender with parallel margins, the strobile filiform with entire margins. These two forms are figured in my former paper. They probably arise from different states of contraction, but it is somewhat singular that each small lot should furnish examples of these two distinct forms.

DISCOCEPHALUM* gen. nov.

[*Δίσκος*, a quoit.]

Body articulate tæniæform. Head composed of two parts. The anterior part a muscular disk, which is entire or notched at the edge. The posterior part (neck), short, globose, with an inflated or corrugated surface. Neck (unsegmented part of body) much narrower than head continuous with the body. No supplemental disks. Genital apertures marginal.

This genus is established to accommodate some peculiar cestoids from the spiral valve of the dusky shark (*Carcharias obscurus.*)

No indication of true bothria nor of supplemental disks was found either in the living specimens or in preserved specimens made transparent with glycerine or oil of cloves; nor could any such indication be found in a series of sections of the head.

On account of the small amount of material and the unsatisfactory results of my study of it, I have determined to put this genus in the family *Tetrabothriidæ* for the present. If my interpretation of the homologies of this form is correct, it should be put in a new family, for which the term *Gamobothriidæ*, also suggested for the problematic genera *Lecanicephalum* and *Tylocephalum*, would be fitting.

14. *Discocephalum pileatum* gen. et sp. nov.

[Plate x, figs. 1–7.]

Head, a transversely-flattened apical disk, entire, or with a single lateral notch, followed by a much smaller, globular, inflated, cervical mass, with botryoidal or corrugated surface, yellowish in color, and separated from the apical disk by a narrow, orange-colored band, unsegmented part of body narrower than head merging into segmented body. Anterior segments very short, much crowded; subsequent segments longer than broad; mature segments irregularly squarish, very changeable in living specimen. Strobile flat, increasing in breadth uniformly to the beginning of mature segments, beyond which point it is somewhat narrower.

Genital apertures marginal a little in front of middle, male and female approximate. Cirrus long and slender, vagina opening in front of cirrus.

Length, maximum 530^{mm}; diameter of anterior disk 3 to 5^{mm}; greatest breadth of body 3 to 5^{mm}.

Habitat.—Carcharias obscurus, spiral valve. Wood's Holl, Massachusetts, July 19, 1886. One adult, three young.

In the single lot of specimens which furnishes the data for this description there are two distinct varieties.

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* This genus is put provisionally in the family *Tetrabothriidæ*.

They may be described briefly as follows:

Var. α.—Apical disk nearly or quite entire. Of this variety there were two specimens; one adult with ripe segments, and which, while living, measures 530^{mm} in length, diameters of anterior disk 3 and 3.5^{mm} respectively; another, a young specimen, measuring in alcohol 40^{mm} in length, diameters of anterior disk 2.1 and 2.2^{mm} respectively.

Var. β.—Apical disk large, with profound lateral notch. Of this variety there were two specimens which did not differ much in size. One of them while living measured 75^{mm} in length, diameters of anterior disc 4.5 and 5^{mm} respectively.

The following measurements of the adult specimen were obtained while it was yet living:

	Milimeters.
Length of specimen	530.00
Marginal diameter of disk	3.50
Lateral diameter of disk	3.00
Thickness of disk	1.25
Diameter of cervical mass	2.00
Breadth of unsegmented part of body	1.12
Greatest breadth of body, 115^{mm} from head	5.00
Length of segments, 115^{mm} from head	1.00
Length of posterior segments	2.45
Breadth of posterior segments	3.25
Longer diameter of ova	0.11
Shorter diameter of ova	0.08

The dimensions of the posterior segments are approximate, the segments themselves being quite variable.

These parasites were found in July, 1886, attached to the mucous membrane of the spiral valve of a dusky shark (*Carcharias obscurus*). When found they were firmly attached, the flat anterior disk being entirely embedded in the mucous membrane of the host. The only part of the head that was visible was the yellow, globular, inflated mass, behind the disk. When the worms were removed, which was effected, in each case, with some difficulty, a flat pit with a narrow opening was left in the mucous membrane.

That part which I have interpreted as the head is a muscular, compact, transversely flattened, terminal disk, which, in the adult and one of the smaller specimens (var. *α*), is slightly convex in front and concave behind, with bluntly rounded entire edges. In the larger specimen there was a very faint indication of a lateral notch on the edge of the disk. In these specimens there was no tendency to appress the sides of the disk. The head, in fact, resembled in shape a cloth-covered coat button, in which the disk represented the flat, exposed part of the button and the inflated cervical mass that part of the button by which it is fastened to the coat. In the alcoholic specimens the disk of var. *α* is convex and yellowish-white above, flat and ashy gray below. On the under side there are three or four radial slits, which are probably cracks in the cuticle, due to the effect of the preservative.

In the two remaining specimens (var. β) there is a decided notch on the edge of the apical disk. This notch is opposite a lateral face of the strobile. In one of the specimens the sides of the disk which are opposite the margins of the strobile are appressed. The apical ridge thus formed was concave in front, so that the disk was shaped like a saddle. In this case the notch was at one end of the apical ridge. In the other specimen the sides of the disk which are opposite the lateral faces of the strobile are appressed. The notch in this latter case is on one of the appressed sides of the disk. The disk in var. β is both relatively and absolutely larger than those of var. α.

With the exception of a tendency to appress the edges of the disk, which movement was accomplished slowly, no motions, either locomotile or those of dilatation or contraction, were observed in the disks of the living specimens.

Immediately behind the broad disk there is a constriction which in the living worm is marked by a narrow orange colored band. Behind this the neck expands into a globular mass, yellowish in color and with a corrugated or fluffy surface. It is much smaller than the anterior disk, and appears to be made up of a number of inflated folds. This part was not observed to change its shape during life; its surface remained pretty uniformly corrugated. The alcoholic specimens show some irregularity, in that some of the inflated folds are much larger than others.

There was no indication of either bothria or auxiliary acetabula on either the disk or the cervical mass, although the latter, as a whole, much resembled the head of a *Phyllobothrium* in a highly contracted condition.

The body in the adult specimen (var. α), immediately after emerging from the cervical mass, increases slightly in breadth, although still quite narrow. Transverse striæ begin a short distance back of the head. The anterior segments are closely crowded together and several times as broad as long. The median segments are rectangular and three times as long as broad. The posterior segments are irregularly squarish. In the living worm the posterior segments change their shape so incessantly that it is difficult to make measurements. The strobile is flat and increases in breadth regularly from immediately behind the head to the first mature segments, from which point the breadth somewhat decreases. The mature segments are squarish, usually broader than long, but quite variable. Near the posterior end there is a tendency towards elongation, so that some segments occur which are longer than broad; others are elongated posteriorly, the posterior end becoming appressed and narrower than the anterior.

The posterior end of the mature segments are, in alcohol, dark colored on account of the ova. There is also a longitudinal dehiscent opening along the median line.

The aperture of the male genital organ is easily seen to be marginal,

usually a little in front of the middle point. The cirrus is very long and, so far as could be made out, is smooth. In order to determine the exact position of the vagina it was necessary to make an examination of thin sections.

One of the two specimens of var. β, after having lain for twenty-four hours in sea-water, measured 75^{mm} in length. For the first 35^{mm} the segments were much crowded and several times as broad as long. The posterior half consisted of segments about as long as broad. The extreme posterior segments were a little longer than broad. The posterior half of the body was much narrower than the antero-median part.

Following are measurements of the living specimens var. β. Length 75^{mm}; lateral breadth of disk, 5^{mm}; marginal breadth of disk, 4.5^{mm}; thickness of disk, 1.1^{mm}; diameter of cervical mass, 2.1^{mm}; length, 1.5^{mm}; breadth of body immediately behind head, 1.15^{mm}; thickness at same point, .35^{mm}; greatest breadth of body, 2.45^{mm}; length of posterior segments, 1.4^{mm}; breadth of posterior segments, 1.3^{mm}.

The strobile, particularly in the vicinity of the median segments, was very active and constantly changing its shape by alternate contraction and expansion.

The smaller specimen of var. α was not measured while living, but as an alcoholic specimen, measured 40^{mm} in length; the two diameters of the disk 2.1^{mm} and 2.2^{mm}, respectively; thickness of disk, .96^{mm}; diameter of cervical mass, .86^{mm}; length of cervical mass, .44^{mm}.

This specimen exhibited a phenomenon in the anterior part of the body, which, if not the result of mutilation, is a curious abnormal freak. For a distance of about 16^{mm} back of the head, beginning at the base of the cervical mass, the body is double. It appears to be double at the point where it leaves the head and where inclosed by the ruffle-like folds of the base of the organ.

A few small, slender, fusiform free segments were found associated with these worms, of which they were at first taken to be the mature proglottides. They were about 3^{mm} long and 1^{mm} broad. After a careful examination of these segments I find that they do not belong to the mature strobile, and I am disposed to regard them as belonging to some other cestod.

It is worthy of note that no parasites were obtained from this shark except the four individuals mentioned in this description, and these free segments, eight or ten in number. The only parts of the shark that were brought into the laboratory were the head and viscera. They were then identified as belonging to a specimen of *Carcharias obscurus*. I am almost tempted now to doubt the validity of the identification, since the parasites are so very different from what I have been accustomed to find in *C. obscurus*.

The cervical mass in the adult specimen was not so distinctly yellow as in the others, moreover the anterior part of the body, immediately behind it, exhibited a faint pinkish tinge, a feature which was not observed in the others.

Structure of head and neck.—A section was made through the anterior disk and carried back through the cervical mass into the anterior part of the body. The latter enters the cervical mass from behind and at first seems to be independent of it, being surrounded by the posterior frill-like lobes of that organ within the cervical mass. The anterior part of the body is seen to enlarge into a kind of central core, which in part, at least, is continuous with the anterior disk, and into which it expands.

The cervical mass while in great measure free from the anterior disk and the inner core, is in reality intimately connected with both. The disk is composed of very densely compacted muscular fibers near the exterior, with a somewhat looser texture in the central portions. The dense tissue of the exterior can be traced back into the core or central part of the cervex. A line of demarkation can be distinguished between the disk and the anterior part of the core, on the one hand, and the crisp folds of the cervex on the other, while at the posterior part of the core no such line of demarkation exists between it and the cervex. Longitudinal muscular fibers from the anterior part of the body continue into the central core, thence some radiate into the frill-like folds of the cervex, while others continue into the anterior disk, where they diverge in all directions to form the latter organ. Branches of the water-vascular system were observed in the anterior disk, the central core, and the inflated folds of the cervex. A section of the latter organ resembles a cluster of racemose glands radiating from a central core. Bundles of muscular fibers radiate from the central core to the deeply and crisply folded exterior. The tissues of this part are very loose and open, and the external folds of the surface are thin and transparent. Although no movement was observed in this organ in the living worm, it is evident from the presence, in considerable quantity, of muscular fibers and the voluminously folded surface as revealed in sections, that it is capable of great change of form. Its loose and delicate structure shows it to be, at least histologically, homologous with the crimped and folded bothria of many of the *Phyllobothrinæ*. The organ doubtless serves an analogous purpose to the bothria of such forms. Its structure shows that it is pre-eminently adapted for absorption. On the other hand the structure of the anterior disk as clearly shows it to be an organ whose chief use is to enable the parasite to adhere to its host.

Musculature of body.—The anterior part of the body, immediately behind the head, as shown in transverse sections, consists of a thick outer layer which appears to be composed, for the most part, of radiating fibers. This layer is succeded within by a narrow layer of circular fibers. The latter surrounds an elliptical central space in which there are longitudinal fibers, most abundant on its outer circumference adjacent to the circular layer. In this central space the cut ends of four aquiferous vessels are seen. These lie in pairs toward the margins. Each pair comprises a larger and a smaller vessel, lying near together, the smaller being the one which is nearer the margin.

The walls of the mature proglottides are very thin. They consist of an outer cuticular layer and an inner granulo-muscular layer. The muscular fibers in this layer are very inconspicuous.

The small amount of material at my disposal has prevented me from making as thorough examination as the importance of the subject demands.

Anatomy of proglottides.—The cirrus is exceedingly long and slender and emerges from a point a little in front of the middle of the margin. The original opening is a little in front of the cirrus. Both sexual organs have a common marginal cloaca which has a thickened muscular border.

The cirrus bulb, when the cirrus is retracted, is oblong, about .28^{mm} in diameter and .6^{mm} in length, and lies at nearly right angles to the margin. The vas deferens is a very voluminous tube which lies near the center of the segment at the base of the cirrus bulb. Some convolutions of this organ in one section were found to be .14^{mm} in diameter, or equal to one-half the diameter of the cirrus bulb. The vas deferens in this case was filled with spermatozoa.

In those segments which immediately precede the ripe proglottides, the anterior part, and indeed the greater part of the interior of the segment, is filled with granular, globular masses from .070 to .086^{mm} in diameter. These were found in longitudinal sections of segments, to be arranged in racemose clusters on branches which are transverse to the axis of the segment. These granular masses evidently represent the testes, and the branches on which they rest, ducts which communicate ultimately with the vas deferens.

Beginning at its exterior end in front of the cirrus at the margin of the segment, the vagina, a tube about .06^{mm} in diameter, passes in front of the cirrus bulb, and in front of and a little to one side of the vas deferens, to the median line of the segment. It there turns abruptly and follows the median line back to the posterior edge of the segment, where it communicates with the ovary. The latter organ is near the posterior edge of the segment. It consists of two lobes which lie symmetrically on either side of the median line. It is made up of a mass of rounded cells, some of which were found to be nucleated and were apparently unfertilized ova. The diameter of the irregular non-nuclear masses was about .013^{mm}. That of the nucleated masses, which had apparently left the ovary and were in the vicinity of the shell gland, was about .016^{mm}. An organ which I take to be the shell gland lies midway between the two lobes of the ovary, is spherical in shape and about .09^{mm} in diameter. It appears to be a somewhat convoluted tube which connects in front with the vagina and also apparently with a median groove or cleft on the face of the proglottis. Posteriorly it connects with an irregular mass which I take to be the vitelline gland. This, when magnified thirty or forty linear diameters, in a section stained with carmine, appeared as an irregular, slightly striated gland,

ular organ, which was sharply differentiated from the surrounding parts and measured .2mm in length and .24mm in breadth. The outlines of the uterus could not be made out from the sections but amber-colored eggs were found in clusters elongated transversely, in marginal prolongations of a median cleft of the proglottis.

In one of the mature segments ova were found that had begun to undergo segmentation. In one case four distinct cells were observed in a single ovum.

Phyllobothrium Van Beneden.

Body articulate tæniæform, head separated from the body by a neck, with four opposite sessile bothria, each bothrium lacinio-crispate on the margin and provided with a single ampulla-like supplemental disk. Genital apertures marginal.

The species which I refer to this genus resembles Van Beneden's *P. auricula*, but differs from it in having the bothria pediceled in marginal pairs, a feature, which, it would seem, requires the generic characters to be emended so as to admit this peculiarity.

I have referred *Phyllobothrium thysanocephalum*, of my former paper to the new genus *Thysanocephalum*, of the sub family *Phyllacanthinæ*.

15. *Phyllobothrium foliatum* sp. nov.

[Plate VI, Figs. 5–10.]

Head broad and flat. Bothria four thin, leaf-like, sessile in marginal pairs, each pair mounted on a short, stout pedicel. Faces of bothria finely reticulated, directed forward; borders of bothria with a distinct row of loculi, and with crenulate margins. Edges of bothria more or less ruffled and folded. Each bothrium provided with a single supplemental disc on its anterior edge. Neck long, broad, and flat, immediately behind the head, quickly narrowing and becoming cylindrical, merging into the body. Segments begin as fine, transverse lines on the neck, first distinct segments very short, appearing as transverse, crowded wrinkles. Subsequent segments increase in length, becoming as long, as broad, and ultimately longer than broad. Mature segments with convex margins, appressed at the two extremities, but most at the anterior end, many of them, therefore, flask-shaped.

In alcoholic specimens, median part of body thickened and fusiform, posterior segments often elliptical, and posterior part of strobile, therefore moniliform, neck sometimes extremely attenuated.

Genital apertures marginal, near middle of margin. Cirrus echinate. Length, maximum, 185mm.

Habitat.—*Trygon centrura*, spiral valve, August 1, 1887, very numerous. August 8, one specimen. August 10, four specimens. Wood's Holl, Massachusetts.

The following measurements are of a living specimen of the first lot: Length, 85mm; breadth of head, 3mm; thickness of head, 1mm; greatest

diameter of face of bothrium, about 1.2mm; diameter of neck, lateral, immediately behind head, 1mm, a little farther back, .4mm; distance to first distinct segment, about 23mm; length of last segment, 1.5mm, breadth, 1.1mm. The longest specimens in this lot measured, while living, from 165 to 185mm.

The head of the living worm in lateral view appears to be distinctly bi-lobed, and very broad. In marginal view it is quite narrow and oblong. Upon a closer examination it will be seen that what appears to be one of two marginal lobes is really a marginal pair of bothria. The latter in the living worm are capable of considerable change of form. The edges are constantly changing their outline, but are usually more or less crinkled or ruffled. This sometimes assumes an apparently ragged appearance, but in no case, so far as I have observed, are the edges of the bothria tattered.

The specimen obtained August 8, 1887, was studied while living rather more carefully than any of the others, and some features noted that were not observed in other cases. I append the following data from notes made while observing the living specimen.

The length of the specimen was 50mm; length of pedicels about .4mm; diameter of pedicel, lateral view, .28mm; breadth of head at bases of pedicels, lateral view, .72mm. Bothria thin, leaf-like sessile on the pedicel which bears each marginal pair. From the manner of their attachment it is difficult to make out their shape. At rest the pedicels point forward with an interval between equal to a little less than the diameter of a single pedicel. The bothria appeared as if bent around the end of the pedicel so that one edge curved into the space between the pedicels, while the opposite edge bent around until it touched the margin of the neck. Each bothrium bears an auxiliary acetabulum on the middle of that margin which lies next to its mate. That is, the auxiliary acetabulum of a bothrium is directly opposite to that of the other bothrium of the same marginal pair. The edges of the bothria, while at rest, project and are slighly incurved, so that the face is concave from the acetabulum to the edge opposite, while it is convex in a line at right angles to this, or, in other words, in the line which joins the two reflexed edges of the bothrium. In a state of activity the bothria effect a progressive movement by prolonging that part of the border which bears the auxiliary acetabula. When in this position the bothria are somewhat triangular, the acetabulum marking the apex of an isosceles triangle, while the base is thrown into about three folds. The edges of the bothria are not broken or laciniate, although often folded in such a manner as to present a laciniate appearance. The edges are finely crenulate, the crenulations being about .3mm in diameter. The faces of the bothria are covered with hexagonal reticulations, like the surface of a honeycomb. The fibrous tissue which forms the frame-work of this reticulated surface, near the edges of the bothria, rises into parallel ribs, so that the outer rim of the thin, free edge of the bothrium, instead of being

reticulated like the remainder of the face, is divided into comparatively regular elongated loculi, about .6mm long and .3mm wide. The rounded ends of these locular cells give a crenulate outline to the edge of the bothria.

An oblong reddish patch .2mm in length and .06mm in breadth, lying transversely to the axis of the body, is situated in the head, about .12mm back of the apex or angle formed by the two pedicels.

On the lateral face of the head four shallow pits or pores were observed, about .05mm apart, along the median line. The first two were narrow, the greatest diameter, about .12mm, transverse to the axis of the body. The third is rounder, deeper, and more evident than the others; its diameter about .08mm.

At the apex of the head, that is, in the angle formed by the pedicels, there was a low papilla not well defined. The pedicels were marked with longitudinal rugæ.

The neck, at a distance of .34mm from the apex of the head, was .64mm broad; at the distance of 1mm it was about .4mm in diameter. Like the head it was flat, thin, and smooth, and decreased in lateral diameter for some 4mm or more back of the head. The aquiferous vessels could be seen passing up to the head and lying, two on each side, about .1mm from the margin. The margins of the neck outside the longitudinal aquiferous vessels seemed to be made up largely of transverse muscular tissue, and the central part of a mass of longitudinal spiral vessels. The latter are shown further on to be bundles of longitudinal muscle fibers. Transverse striæ appeared about 7mm from the head. The first distinct segments were about .04mm long and .4mm broad. Towards the posterior end the segments became squarish, then longer than broad. Near the posterior end the segments grew somewhat narrower. At 10mm from the posterior end the segments were .5mm long and .72mm broad; the last segment was 1mm in length and .34mm in breadth. The posterior segments of this specimen in alcohol are elongated, with nearly parallel margins; the strobile is therefore not moniliform, as is usual in the specimens of the other lots.

The foregoing description is based on a specimen that had lain for twenty-four hours in sea-water. It was still capable of motion, and was at first rather transparent. After some two hours more the head and bothria became opaque, and the latter contracted. The measurements were made while the specimen was lying free in the water.

In the specimens of the lot collected August 1, from which the sketches of living forms were made, the red pigment spot in the head was not observed, neither were the lateral pits nor the terminal papilla, which was faintly indicated in this specimen. In the specimens collected August 10, I recorded in my notes the following observations: Head and body yellowish white, neck bluish white; last segments with large ivory-white opaque spot in the center.

The following data are from the larger lot and hence represent more general characters.

The meshes of the reticulations on the face of the bothria are about .04^{mm} in diameter. The effect of this reticulation, of the crenulated border, of the marginal row of loculi, and of the ramifications of the water vascular system on the transparent bothria of the living worm is very striking. It is a very beautiful object indeed. The loculi on the borders of the bothria in alcoholic specimens measure .05 by .07^{mm}, outside diameters, and .03 by .04^{mm} inside. The auxiliary acetabulum, while usually visible on the anterior edge of the bothria of living specimens, is often found only with great difficulty in the alcoholic specimens.

There is really no head, properly speaking. The neck simply becomes a little broader towards the anterior end and bifurcates, thus forming the two fleshy columns or pedicels which support the marginal pairs of bothria. In the alcoholic specimens the bothria are somewhat contracted and the pedicels shortened, so that the head loses something of its distinctively bilobed appearance and in lateral view appears to be transverse, making with the neck a figure like the letter T. The crenulated borders are much folded and crumpled.

The character of the neck is much the same in all as in the specimen already described, except that the four large aquiferous vessels which lie in pairs about midway between the median line and the margins are usually sinuous. In general the neck is flattened and rather broad near the head. It soon grows narrower and for some distance is nearly cylindrical. In the living specimens the surface appears to be perfectly smooth for the first 7 to 12^{mm}, at which point fine transverse lines are discernible, which a little farther on give rise to the first segments. In the alcoholic specimens, however, fine transverse lines occur immediately behind the head.

At the point where the segments begin there is, in the living worms, a slight enlargement of the neck, at which point, in some, the inner tissues of the neck appear to end abruptly in a rounded stopper-like termination, which, like the neck proper, is more transparent than the body which follows. This abrupt transition from neck to body is not so apparent in the alcoholic specimens, but in all there is a rather sudden enlargement about the point where the first segments begin.

When these worms were placed in Perenyi's fluid they contracted to nearly one-half their length in sea-water, and with few exceptions assumed a highly characteristic shape. The head is contracted, loses its forked or bilobed appearance, and viewed laterally is oblong and placed transverse to the neck. The latter is rather narrow, cylindrical for about 8^{mm}, when it enlarges rapidly and merges into the body. The maximum breadth is soon attained, and for some 12^{mm}, more or less, varying with the size of the specimen, remains of nearly uniform size. The breadth is apt to decrease slightly with the maturing segments. The latter are squarish. The specimens which have many mature seg-

ments become decidedly moniliform posteriorly, each proglottis becomes compressed anteriorly until it is reduced to a mere neck. It is also compressed, but not so much, posteriorly. The margins are therefore strongly convex. There is a tendency also on the part of some of the posterior segments to assume an arcuate form, in which one of the lateral faces is convex and the opposite one concave. Most of the alcoholic specimens are somewhat fusiform, and the last segment is elongated and compressed posteriorly as though the strobile had not yet lost any segments.

While examining the living specimens of the large lot I was for a time disposed to think that there were two species, or at least two varieties. A few appeared to be destitute of auxiliary acetabula. The heads were smaller and the bothria had thinner margins than was the case in the majority of examples. When the specimens were placed in alcohol, six out of the forty-eight individuals at once assumed a marked difference in form. The heads became flatter and thinner, somewhat flaccid, truncate in front, and wedge-shaped; the necks were much attenuated, even filiform, while the posterior end of the strobile was more decidedly moniliform than in the normal type. This difference, while quite striking, is, I think, due simply to difference in age and conditions of contraction. It is to be noted that most of the individuals with the slender necks are considerably longer than the others and have a much larger proportion of mature segments. In the one or two whose length does not exceed the average of the normal type, there is an appearance of general flaccidity as though the individuals were imperfectly developed. The difference between the two sorts with respect to the bothria is probably due to a deterioration on the part of the smaller lot, a conclusion which is further strengthened by the general appearance of maturity of the strobiles.

In the following table of measurements, Nos. 1 and 2 belong to the smaller lot, that is, those with the attenuated necks, Nos. 3 to 6 to the larger lot, or normal type. All the measurements are of alcoholic specimens:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Length	76.00	45.00	30.00	46.00	46.00	28.00
Breadth of head	.90	1.60	1.48	1.60	1.40	1.50
Thickness of head	.36	.50	.60	.60	.70	.50
Diameter of neck near head, lateral	.28	.34	.56	.68	.56	.56
Diameter of neck at narrowest point	.08	.15	.40	.60	.40	.40
Distance to first segment	14.00	12.00	12.00	10.00	10.00	10.00
Length of first segment (approximate)	.02	.02	02	.02	.02	.02
Breadth of first segment	1.00	.90	1.00	.80	.60	.80
Greatest breadth of body	1.00	.94	1.50	1.06	.80	1.60
Length of last segment	1.40	1.30	1.60	1.30	1.30	.80
Breadth of last segment	.90	.76	.80	.80	.70	.76

The posterior segments of corresponding degree of development in the two sorts do not differ materially in their anatomy.

Anatomy of posterior segments.—The posterior segments of the alcoholic specimens are opaque near the margins and transparent along the median region. The opacity of the marginal regions is due to great numbers of granular bodies about .03^{mm} in diameter. These marginal granular masses evidently represent the vitelline glands. The ovaries are two pale, oval organs lying one on each side of the lateral line at the posterior end of the segment. Each is about .28^{mm} long and .15^{mm} broad. In section, when highly magnified, the ovaries are seen to be made up of small polygonal cells about .005^{mm} in diameter. The vagina opens immediately in front of the cirrus. The two organs have a common external opening, situated near or a little in front of the middle of the margin. The vagina at first follows the front side of the cirrus bulb, and then continues as a much convoluted tube, in an irregularly sinuous course to its termination in a bulbous enlargement between the lobes of the ovary. An elongated and rather broad organ, appearing in section to have ruffled or lobed margins, occupies the middle of the segment, extending from the ovary nearly to the anterior edge of the segment. In longitudinal sections this organ shows a number of empty spaces and others filled with fine granules; I take it to represent the uterus, as yet destitute of ova. The vas deferens is a voluminous, convoluted tube lying near the anterior end of the segment and adjoining the base of the cirrus bulb. In sections this organ was densely and finely striated, due as I infer to the spermatozoa which fill it. No ova were found in any of the segments.

The cirrus is of moderate length. As it was retracted in every case its exact length could not be ascertained. One was estimated to be .25^{mm} in length; the diameter of the base was in one case .036^{mm}, in another .03^{mm}. Another was .38^{mm} long, diameter of base .05^{mm}, middle .027.^{mm} The cirrus bulb is pyriform, its length equal to about one-third the breadth of the segment, the large end inward. The cirrus is covered with minute, recurved spines which are about .002^{mm} in length. When highly magnified the margins of the segment are finely serrate.

Anatomy of head and neck.—Transverse sections of the head and part of the neck of a specimen stained with carmine furnished the following data:

The superficial tissue of the bothria is mainly granular. The thickened, crenulated border is composed of short radiating fibers with a few longitudinal interspersed and a layer of circular fibers as its base. Very coarse muscular fibers .005^{mm} in diameter, which originate by the splitting up of the large fascicles of longitudinal muscles of the neck, radiate from the center of the head, and constitute the predominant tissue of the two pedicels. The vessels of the water vascular system apparently originate at that part of the bothria where the edges of a marginal pair approach each other.

A transverse section of the neck near the head presents a highly characteristic appearance. The outer part consists of two thin but sharply-defined layers. The outer or cuticular layer is made up, in part, of circular and possibly of longitudinal fibers. The inner layer is also a layer of circular fibers. Within this is a somewhat indefinite, narrow region of granular material. Within this again is a very thick coat of longitudinal muscles surrounding a central space which contains the aquiferous and nervous vessels. These longitudinal muscles are collected into broad fascicles, placed side by side and standing radially around the central space. This coat is from .05 to .06^{mm} thick. These dimensions represent the breadth of the muscle fascicles. The thickness of the latter is from .008 to .016^{mm}. These masses of muscular tissue, although parallel, do not yield sections with symmetrical sides. They have, in fact, a crinkled or folded outline. The appearance of central vessels, noted in the neck of the living worm, is thus clearly explained. That appearance is caused by these bundles of longitudinal muscles. In the center of the neck they would, of course, be seen in the direction of their greatest diameter, and would therefore appear more opaque than the surrounding tissues. They would not be defined towards the margins, because there they would be seen in the direction of their least diameters, and moreover several lying in the same enfilading line of vision, they would therefore appear homogeneous.

The central space, in transverse sections, appears as two oval spaces lying toward the margins and connected at the center by a very narrow line, where the opposite lateral sides of the longitudinal muscle layer almost meet. In each marginal compartment of this central space lie the two aquiferous vessels and another, which I take to be a nervous vessel. Of the two aquiferous vessels, the one in each pair which is the nearer to the center of the neck is the larger. Each is provided with a wall .003^{mm} thick, which is very sharply defined from the surrounding granular tissue. The cross-sections of these tubes are oval, and yield the following measurements: Larger vessels, longer diameter, .027^{mm}; shorter, .019^{mm}; smaller vessels, longer diameter, .015^{mm}; shorter, .012^{mm}. The longer diameters of these sections nearly coincide with the breadth of the longer diameter of the neck. The measurements given above include the walls of the tubes.

Lying close to the marginal side of each pair of aquiferous tubes is another vessel, which I take to represent the nervous system. In transverse sections of the neck, stained with carmine, these appear at first as circular and later as oval patches, which are plainly differentiated from the surrounding tissue, but are destitute of the thick limiting walls which characterize the aquiferous tubes. These nervous channels are filled with a fine granular tissue, which is but little affected by the staining fluid, although the surrounding tissues are, without exception stained deeply. Where first observed, at the base of the head, the cross-sections of these nervous vessels was circular and .02^{mm} in diam-

eter. A little farther back they are oval, and measure .02mm and .01mm along the two diameters.*

This species is evidently near Van Beneden's *Phyllobothrium auricula* (Mem. Vers. Intest., 124, Plate XVI, 6–12), from *Trygon pastinaca*.

ANTHOCEPHALUM, gen. nov.

Body articulate tæniæform; head separated from body by neck; bothria four, unarmed, cruciformly disposed, mounted on very versatile pedicels, which contract in alcoholic specimens so as to appear sessile. Borders of bothria very flexible, crenulate, with a single supplemental disc on anterior edge; face smooth, no myzorhynchus; genital apertures marginal.

The alcoholic specimens suggest the genus *Phyllobothrium*. The distinctly pediceled bothria, however, which were quite evident in the living specimens, exclude them from that genus. The crenulate border of the bothria, which is caused by a row of small loculi, the long neck and the slender, versatile pedicels exclude them from the genus *Crossobothrium*. The immature segments of the strobile bear a strong resemblance to those of *Spongiobothrium variabile*.

16. *Anthocephalum gracile*, sp. nov.

[Plate VII, Figs. 1 and 2.]

Head in the living worm with four leaf-like, opposite bothria, mounted on very flexible pedicels. Each bothrium with a single supplemental disk on the inner anterior border, and a marginal row of small loculi. Face of bothria smooth; edges very flexible, crenulate. In the alcoholic specimens the pedicels are usually contracted, so much so, in some cases, that the bothria appear sessile. The head is then broad, subglobose; the margins of the bothria are entire, but with a tendency to lie in crinkly folds. The short-ribs which form the marginal row of loculi and the crenulate border are prominent, especially in specimens made transparent in some refractile medium. The bothria are somewhat triangular in shape, with the apices directed forward; each one, in fact, bears some resemblance to a cocked-hat.

The neck is short, subcylindrical, and merges imperceptibly into the body. The segments are at first indicated by fine transverse lines. The first distinct segments are much broader than long; next squarish, then oblong. The entire neck and body are slender, linear, and much narrower than the head. Mature proglottides not seen. Genital apertures marginal, about posterior fourth.

*I take advantage of the opportunity afforded by the passage of the proof sheets of this paper through my hands to note that the above general observations on the musculature of this species agree in many particulars with the more detailed researches of Dr. Fritz Zschokke on *P. thridax*, in his admirable monograph on the Anatomical and Histological Structure of the Cestods. (*Recherches sur la Structure Anatomique et Histologique des Cestodes*. Mém. Inst. nat. Genév. Vol. XVII, 1888.)

Habitat.—Trygon centrura, spiral valve, two specimens; August 1, 1887, Wood's Holl, Massachusetts.

The specimens were immature. The larger afforded the following measurements while living:

	Millimeters.
Length	17.00
Length of bothria	.60
Breadth of bothria	.50
Diameter of pedicel	.14
Diameter of head at base of pedicels	.46
Diameter of neck immediately back of head	.16
Diameter 4^{mm} back of head	.12
Distance to first distinct segment	.60
Length of first distinct segment	.04
Breadth of first distinct segment	.12
Length of last segment	1.60
Breadth of last segment	.28

As the measurement .4^{mm} back of the head shows, there is a slight narrowing of the body at that point. There is, in fact, a slight constriction, for the diameter immediately increases again from .12 to .14^{mm}. In the alcoholic specimen the breadth of the head, including the bothria, is .8^{mm}, the length .6^{mm}, diameter of the anterior part of the body .14^{mm}, length of posterior segment 1.16^{mm}, breadth .3^{mm}.

The posterior segments are not mature. They agree very nearly, however, with the median segments of *S. variabile.* The segments in question are slender, rectangular with slightly rounded angles. The ovaries lie at the posterior end of the segment on either side of the median line. The two oblong oval lobes are confluent at their posterior ends and extend forward along the margins to the vicinity of the cirrus pouch. The latter is not yet clearly defined, but enough to show that the genital apertures are marginal and situated about the posterior fourth. In front of the genital aperture the interior of the segment is filled with the globular spermatic capsules of the testis. They are about .04^{mm} in diameter. Along each margin inside of the muscular wall there is a narrow space filled with small granular bodies. This space is limited on the inner side by the slightly sinuous aquiferous vessels.

The resemblance of the strobile of this species to *Spongiobothrium variabile* is so close as to lead me to suspect that it might be the young of that species. The lacinio-crispate bothria of *S. variabile* might easily be conceived to develop from the simpler leaf-like bothria of *Anthocephalum gracile.* The fact, however, that the bothria in *S. variabile* are in distinct lateral pairs, while in *A. gracile* they are almost cruciformly disposed, reveals a difference so profound that it is not only extremely unlikely that the one form should follow the other in the same individual, but is sufficient to create a just doubt as to whether that would be a true classification which would refer them to the same genus. Moreover, no supplemental disks have been discovered in *S.*

variabile while in *A. gracile* they are quite distinct in living specimens, although it must be confessed they were found with extreme difficulty in the alcoholic specimens.

ORYGMATOBOTHRIUM, Diesing.

Body elongated, articulate depressed. Head separated from body by a neck, with four opposite cup-shaped bothria, attached by a contractile pedicel, highly versatile, and each provided with two scrobiculiform supplementary disks (*auxiliary acetabula*). Genital apertures marginal. (*Diesing.*)

Van Beneden originally described the species *O. versatile* Dies. under the name *Anthobothrium musteli.* The species was taken out of the genus *Anthobothrium* by Diesing on account of the two supplemental disks on each of the bothria.

The name *Anthobothrium* was retained by Diesing, and is used in this paper, to designate those *Tetrabothriidæ* whose bothria are unprovided with auxiliary acetabula.

With regard to the supplemental disks at the center of the bothria Van Beneden says:

Upon studying these appendages (bothria) with the aid of a compressor, other characters appear which seem to be peculiar to this species. In the middle there is a circular band surrounded with fascicles of muscular fibers making a circle at the center which produces the effect of a cupping disk.

The essential generic characters of these specimens, from *Carcharias*, are about as follows:

Body elongated, articulate, depressed. Head separated from body by a neck, with four opposite cup-shaped bothria attached by short contractile pedicels, highly versatile, each provided with a single supplemental disk on anterior end of border. Border of bothria entire, without loculi. Genital apertures marginal.

In *O. crispum* (*Tetrabothrium* (*Anthobothrium*) *crispum* Molin), the second of the two species which Diesing includes in this genus, it appears to me, judging from Molin's figure, that the "central umbo" of that author, while probably of the same nature as Van Beneden's "circular band," is not to be regarded as a supplemental disk.

Whatever may be the final disposition of the genus *Orygmatobothrium* there can be little doubt of the relationship of *O. angustum* to Van Beneden's *Anthobothrium musteli.**

17. *Orygmatobothrium angustum* Lt.

[Plate VII, Fig. 3.]

Report of U. S. Fish Commissioner for 1886, pp. 468–9, Plate III, Figs. 1–3.

In the summer of 1887 I obtained this parasite of the dusky shark (*Carcharias obscurus*) on two different occasions. I give the following

* Zschokke's admirable monograph, *Recherches sur Structure Anat. et Hist. des Cestodes* (Mém. Inst. nat. Genév., Vol. XVII, 1888), which reached me before these notes were published, leaves no doubt whatever about the presence of two auxiliary acetabula on each bothrium of *Anthobothrium* (*Orygmatobothrium*) *musteli* Van Ben., and of *Orygmatobothrium longicolle* Zschokke.

emended description of the species, together with some additional data resulting from a study of living specimens:

Head, when bothria are at rest, pyramidal, bothria four, triangular or ovate, terminating in front in a narrow rounded point, broadly rounded at posterior end, with a thickened, entire border, sessile, or at least pedicels not evident. Each bothrium terminated at anterior end by a supplemental disk. Neck long. First segment squarish, subsequently longer than broad; posterior segments four or five times as long as broad and usually rounded at the extremities. Neck and segments with fine parallel, transverse furrows which give a serrate outline to margins. Genital apertures marginal, opening near anterior fourth. Length as great as 35mm.

Habitat.—Carcharias obscurus, spiral valve, very abundant; July and August, Wood's Holl, Massachusetts.

The following measurements of strobile and last segment are from the living specimens:

Dimensions.	No. 1.	No. 2.	No. 3.
	mm.	*mm.*	*mm.*
Length	35.50	32.00	17.50
Length of last segment	3.00	2.50	1.60
Breadth of last segment	0.50	0.55	0.30

The following additional measurements are from No. 3, specimen slightly flattened under the compressor: Breadth of head, anterior, .32mm; breadth of head, posterior, .6mm; length of neck, 2.8mm; breadth, .18mm; length of first distinct segment .2mm, breadth, .36mm.

One lot of specimens obtained August 12 contained only sixteen individuals of this species. On July 25, however, a very careful search was made for Entozoa in a dusky shark and with astonishing results. Besides several specimens of *Anthobothrium laciniatum* and *Phoreiobothrium lasium*, there were in the neighborhood of four hundred specimens of *Tetrarhynchus bisulcatus* and enormous numbers of the species under consideration. The chyle of the intestine was absolutely swarming with them. They were saved and partially assorted at the Wood's Holl laboratory. During the following winter I attempted to complete the assorting of this lot in order to find out the exact number of these parasites, but found the work insufferably tedious. The worms are in many cases felted together in a tangled mass which can not be untangled except by mutilating the strobiles. This peculiar felting together along with a kind of tough or indurated secretion was observed when the worms were first removed from their host. I have examined this unassorted lot carefully for other species, but succeeded in finding only the species mentioned above, which were separated from the lot at the time of collecting.

Desiring to form some idea of the number of individuals in this lot, I attempted to separate them from the tangle of strobiles and chyle, so

that they could be counted. I continued this work as long as my patience and the time at my disposal lasted. Upon counting the specimens that I had thus separated I found that there were one thousand nine hundred and sixty-three. In numbering the specimens I counted only the scolices. As the number was so near two thousand I returned to the work of assorting, and in a few minutes added fifty more scolices to the above number. One may therefore be very safe in saying that there were over two thousand individuals of this species in the spiral valve of this dusky shark. There yet remain several hundred specimens in the unassorted lot. The specimens of this lot vary in size from 5 to 30^{mm}. The short specimens are doubtless in most cases fragments of longer strobiles. The alcoholic specimens show a great variety of size and proportions, due to different stages of contraction. Some are slender and filiform, others so thick as to be almost wedge-shape. Between these two extremes there are a great variety of gradations.

Two distinct kinds were recognized among the living specimens. One very slender, transparent, bluish white; the other stouter, shorter, opaque, and ivory white. These differences are plainly due to different states of contraction. One of the former had the following dimensions while living: Length, 27^{mm}; breadth of neck near head, .1^{mm}; segments begin about 6^{mm} back of the head; length of posterior segment, 3.2^{mm}; breadth, .32^{mm}.

The bothria, while quite active during life, do not exhibit a very great diversity of outline. Their anterior ends frequently elongate and curve outward and back in horn-like prolongations. An opposite movement is that in which the anterior ends of the bothria are closely appressed and the broadly rounded posterior ends are curved outward and forward. These movements give to the head quite diverse outlines, but with all the flexibility of the bothria they were not observed to exhibit any tendency to crumple or become folded on the margins. In the alcoholic specimens, however, there is a tendency in the edges of the bothria to become more or less irregular in outline. Some of the specimens have the edges of the bothria slightly folded. There are no loculi along the border.

This cestod can be very easily recognized by the fine transverse furrows and ridges which give the margins of neck and segments a serrate outline. These can be seen with low magnifying powers. In some of the alcoholic specimens this feature is somewhat indistinct, as if the epidermal tissue had become loosened by the preserving fluid.

None of the posterior segments contained ova. The ovaries are rather small, paired organs at the posterior end of the segment. The vagina, originating between the ovaries as a convoluted tube, can be traced along the median line to the cirrus bulb, around which it bends like the handle of a shepherd's crook, to open beside and in front of the cirrus in a genital cloaca common to both vagina and cirrus. The latter is long and slender. It was retracted in every case, and its exact length

could not be determined. It is about .03mm in diameter at base. The interior of the segments was filled with long, oval masses, which lie close together and at right angles to the long axis of the segment and along the central part of the segment on each side of the median line. In the anterior part of the segment the masses are globular, and along the margins smaller and granular.

The cirrus bulb lies in the crook of the vagina, and contains, besides the retracted cirrus, a part at least of the vas deferens. When thin sections of a stained segment were made, the cirrus was found to be covered with exceedingly minute spines. The long-oval masses in the interior of the segment now appear densely granular, or like nests of nuclei in some of the segments; in others which are more mature they are not so much elongated, and contain both nuclei and fibrous tissue.

This species is apparently near Van Beneden's *Anthobothrium musteli* (*Orygmatobothrium versatile* Dies., Revis. Ceph. Par. p. 276). I have, however, experienced the same difficulty in finding a second supplemental disk in the center of the bothria, as in the case of the specimens which furnished the material for my former description. I notice the same curved band of muscular fibres crossing the faces of the bothria about the anterior third. This does not rise into a transverse rib.

I am not at all satisfied that there is a second supplemental disk (*auxiliary acetabulum*) in this species. It is certainly very faintly outlined by the curved band of muscular fibres.*

Crossobothrium Linton.

18. *Crossobothrium laciniatum* Lt.†

[Plate vii, Fig. 4.]

U. S. Fish Commission Report for 1886, pp. 469–474; Plate iii, Fig. 4–18.

I have already given a tolerably full account of this parasite of the sand shark (*Odontaspis littoralis*).

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* In attempting to follow Diesing's system of classification of the unarmed *Tetrabothriidæ* I have experienced much perplexity, and nowhere more than among the forms kindred to those which Van Beneden has grouped under the generic name *Anthobothrium*.

The specimens which I have referred to the genus *Orygmatobothrium* possess many of the characters ascribed to the genus *Monorygma* Dies. There is, however, no myzorhynchus, unless an indistinct papilliform apical termination of the head be regarded as such.

Diesing's genera *Orygmatobothrium* and *Monorygma* are included by Van Beneden in his genus *Anthobothrium*.

† This species bears a close resemblance to Oerley's *Orygmatobothrium Dohrni: Die Entozoen der Haien und Rochen*, p. 219, pl. x, figs. 16–19, *Phyllobothrium Dohrni* Oerley,—Zschokke, *Mém. Inst. nat. Genév.*, vol. xvii, 328–338, pl. viii, fig. 138 and pl. ix, figs. 139–144.

In the summer of 1886 and 1887 I had several opportunities of examining this shark. In each instance I found this entozoon in abundance, and usually no others. I take the following data from my memoranda made at the time of collecting:

August 2, 1886.—Eighty-one specimens of *C. laciniatum*, adult and young, obtained from the spiral valve of a single sand shark (*O. littoralis*). The chyle was swarming with mature proglottides. One individual of this lot differed from all other specimens of this parasite that I have yet seen in having a moderately elongated neck. In the normal form the neck is short and corresponds to one of the anterior segments. A description of this unusual form is given below. No other entozoon found, except a few cysts (*Xenosites* Van Beneden) in the muscular coats of the stomach and intestine.

July 13, 1887.—Seventy-five specimens of same parasite, young and adult; same host; no other entozoon found.

July 22, 1887.—Fifty-three specimens of same, maximum length 160^{mm}; same host; no other entozoon.

August 12, 1887.—Ninety-two specimens of same, mainly immature, maximum length 40^{mm}; same host; also five small *Rhynchobothria* and one Nematod.

August 13, 1887.—Forty-four specimens, mainly adult, maximum length, 125^{mm}; same host; also five Nematods, four large and one small, with their heads embedded in the mucous membrane of the stomach, near the pyloric constriction. In this lot there was an abnormal form which measured only 18^{mm} in length, but which had mature segments. This form is more fully described below.

Variety longicolle.—The abnormal form found in the lot of August 2, 1886, deserves something more than a passing notice. It is the only one of all that I have yet found that has a distinctly elongated neck. In other cases, with this single exception, the length of the neck, that is, the distance from the bases of the pedicels of the bothria to the first segment, is about equal to the length of the first segment. In other words, the segments begin immediately behind the head.

When first measured, which was after it had lain in sea-water about eighteen hours, the length of this specimen was 14.7^{mm}, the length of the neck 2^{mm}. The first segment at this time was enlarged and inflated. This latter feature disappeared in a few hours and the neck became relatively longer and thinner. After having been in sea-water for twenty-four hours, the length of the specimen was 21^{mm}, its neck 5^{mm}. There were eighteen segments in the strobile, all of which seemed to be adult and equally developed, while the last two were mature and contained ova. In this respect it was in sharp contrast with the other individuals of this and other lots, which had mature segments. These, as a rule, measured from 100 to 200^{mm} and over, in length, the anterior and median segments being immature. On the other hand, the dimensions and general appearance of the head and bothria are in no essential

particular different from the normal type. The neck, which presents the greatest apparent difference, can hardly be taken, from this isolated example, as a type for a new species. If that part of the head which lies behind the bothria in a normal individual were stretched out, which it may have the power of doing, there would then result a form of neck exactly like that which characterizes this abnormal specimen.

The absence of segments corresponding to the anterior and median immature segments of the normal individuals constitutes a difference which is much more difficult to reconcile with the typical specific characters. If other forms should be discovered answering to this, which I conceive to be an abnormal form, the discoverer would be justified in erecting a new species. It may be regarded at present as a variety.

The arrangement of the genital organs in the posterior segment is normal. The segments likewise have a lateral opening for the escape of ova. The size of the ova is the same, viz, .02 to .03^{mm} in diameter. When placed in alcohol the segments contracted very much in length, while the neck remained relatively unaffected.

Of the specimens, detailed measurements of which are given below, No. 1 is the abnormal form, No. 2 normal, here repeated for comparison. The dimensions of the abnormal specimen are those recorded when it was first measured:

Dimensions.	No. 1.	No. 2.
	mm.	*mm.*
Length	14.70	195.00
Length of head	1.00	1.45
Breadth of head	2.00	1.80
Length of neck	2.00	.....
Diameter of neck, middle	.18	.....
Length of first segment	.70	.50
Breadth of first segment	1.05	.70
Length of last segment	1.40	1.60
Breadth of last segment	1.23	1.90

In No. 2 no dimensions are given for the neck. The dimensions given for the first segment, however, do not differ materially from those of that part of the head which lies behind the bothria.

In the lot obtained August 13, 1887, among quite normal forms, were some which bore mature segments although much shorter than the normal strobiles. In one of these anomalous forms, measuring 18^{mm} in length, the head and first twenty segments were normal in shape and size and character of the flaps. From the twentieth to the twenty-fifth segment the breadth of the strobile increased rapidly from less than 1^{mm} to about 3^{mm}. There were thirty-six segments in all. The last ten or twelve were about the same breadth, that is, 3^{mm}, and each was about 1^{mm} in length. There were a few other specimens which were much like this one, but longer. They were, in fact, transition forms between it and the normal type.

The individuals of this species are usually an opaque, ivory-white color. A few in one of the hosts were observed to be tinged with a greenish color. This may have been due, however, to the action of some food which had been taken into the alimentary canal of the host a short time before the specimens were collected.

LECANICEPHALUM *, gen. nov.

[λεχανίς, a platter.]

Body tæniæform, articulate, head transversely flattened, circular or subquadrangular, and consisting of two disciform plates. Posterior plate with four supplemental disks (auxiliary acetabula). Neck short or none. Genital apertures marginal.

Van Beneden mentions (Poiss. des côtes Belgique, I, Parasit. et com. p. 19, Plate v, fig. 13), among the parasites of *Trygon pastinaca*, a genus which he names *Discobothrium*. The name which he gives to the species is *D. fallax*. He publishes no description of the worm, but figures the head and anterior segments. The figure is a good one, but there is no explanation of the number of times it is magnified. When, however, one is obliged to choose between a short description and a good figure in the identification of the Cestoda, the latter is to be preferred. Van Beneden's figure of *D. fallax* shows it to be a Cestod, with a thick, muscular anterior disk surmounting a quadrangular base, the angles of which are prolonged into prominent tubular bothria, the sucking-disks of which are circular.

Although I do not feel justified, from such meager data, in referring a parasite, which I have obtained on three different occasions from the spiral valve of *Trygon centrura*, to the genus *Discobothrium*, I yet find sufficient resemblance between Van Beneden's figure and my specimens to incline me strongly to the belief that they are closely related, if not generically identical. The near relationship, if not actual identity, of their hosts, makes the close affinity of these parasites the more probable.

19. *Lecanicephalum peltatum*, sp. nov.

[Plate IX, Figs. 2–4.]

Head nearly circular, disciform, and joined to the neck or anterior part of the body at the middle of the posterior side, after the manner of a peltate leaf. In the living worm the head looks like two thin plates, placed the one on top of the other. The anterior plate is almost circular with their edges, which are more or less ruffled or irregularly crenulate. In preserved specimens they are sometimes so much folded at the edges as to obscure the characteristic disciform shape. The second,

* The genera *Lecanicephalum* and *Tylocephalum* are put among the *Tetrabothriidæ* although neither genus possesses the characteristic bothria of the family. It may become necessary, upon further examination of these interesting forms, to put them in a distinct group under the name *Gamobothriidæ* or some equivalent term.

or posterior, plate is of about the same thickness as the anterior one, and, in the living specimen, is nearly circular, and bears four supplemental disks (auxiliary acetabula), which are nearly equidistant on the margin. In the alcoholic specimens, however, the posterior plate is found to be somewhat smaller than the other. Its margins are entire, smooth and quadrangular. The largest sides of the quadrangle correspond to the lateral sides of the strobile, and the supplemental disks are at the angles. In some cases the angles which bear the supplemental disks are slightly prolonged.

The supplemental disks are directed sometimes forward, sometimes backward. Their usual direction is probably outward, or at right angles to the axis of the body. The diameter of a single disk, measured in an alcoholic specimen, is .1^{mm}.

The neck, or anterior part of the body, is attached to the posterior side of the disk-shaped head, like the petiole of a peltate leaf to its blade.

Segments begin about 1^{mm}, or less, back of the head. The first distinct segments are broader than long. The segments are, at first, rather flat, squarish or rectangular, with parallel sides and sharp angles, but as the reproductive organs begin to mature, the segments become rounded and somewhat thickened, giving a moniliform outline to the strobile. The posterior segments are considerably elongated, sometimes bacilliform, rounded at the angles and slightly constricted at the ends, at other times elongated and rectangular.

Reproductive apertures marginal, a little in front of the middle of the segment. Cirrus bulb large, oval, with anterior prolongation. Cirrus echinate.

Habitat.—*Trygon centrura*, spiral valve, July 29, 1886, July 10, 1887, and August 1, 1887. Wood's Holl, Massachusetts.

I have obtained this entozoon on three different occasions, each time from the spiral valve of the sting ray (*Trygon centrura*), and each time but few specimens. The first lot contained but one specimen; the others four or five each.

The following measurements were made on living specimens, one from each lot:

Dimensions.	No. 1.	No. 2.	No. 3.
	mm.	*mm.*	*mm.*
Length	8.20	12.50	14.00
Diameter of head	.90	.68	.80
Thickness of head	.....	.....	.40
Diameter of neck	.16	.12	.14
Distance to first distinct segment	.....	.20	1.00
Length of first segment	.04	.02	.10
Breadth of first segment	.16	.12	.18
Length of last segment	.85	1.50	.80
Breadth of last segment	.30	.32	.26
Number of segments	.....	60	.....

In No. 1, which was lightly distorted under the compressor, the head measured across the top 1.4mm and was quite thin, as shown in the sketch (Fig. 2). The dimensions of alcoholic specimens differ but little from those of the living specimens.

Although in this species the bothria, being represented by the undivided posterior disk of the head, are strictly one, the occurrence of four definite auxiliary acetabula on the margins of the bothrial disk shows its relationship to the family *Tetraphyllidæ*. The anterior plate or disk is probably to be regarded as homologous to the myzorhynchus of *Echeneibothrium*.

Although the head of *Lecanicephalum peltatum*, as a whole, is somewhat suggestive of Van Beneden's figure of *Discobothrium fallax*, the differences are also very profound. Indeed, the figure of *D. fallax* suggests some of the forms of *Echeneibothrium variabile*, especially one figured by Olsson (Lunds. Univ. Årssk., Vol. III, Plate I, Fig. 15).

Anatomy of posterior segments.—Two posterior segments were stained with hæmatoxylon and cut into longitudinal sections. They furnished the following data: The segments were about .7mm in length and .24mm in breadth. The body wall is composed of two layers. The outer of these is a musculo cuticular layer, which is characterized by having a transversely crackled appearance; the broken lines which produce this effect are about .01mm apart. The inner layer of the body wall is coarsely granular, the granules being very irregular in shape.

The genital aperture is marginal, and in a section measuring .7mm in length was exactly .3mm from the anterior end. Under a low magnifying power the genital aperture appears to lead directly into a somewhat pyriform clear space, which is .16mm long and .08mm broad, and is directed towards the anterior end at a sharp angle. Its anterior extremity was, in one case, only .16mm from the anterior end of the segment. When the sections are examined under a magnifying power of from 250 to 300 diameters, the appearance of this apparent cirrus bulb is very remarkable. It is then seen to be lined with a dense coat of very fine bristle like spines, which point towards the external aperture. The true nature of this bulb is thus revealed. It is in fact the base of the cirrus itself, and lies in a larger cavity, which also contains additional coils of the cirrus. The walls of the true cirrus bulb appear to be thin and weak in proportion to the size of the organ to be evaginated. The diameter of a section of one of the folds of the cirrus lying beside the enlarged base was .02mm. The shape and appearance of the cirrus when extruded must be very remarkable. It is evidently quite long. The spines with which it is beset are quite slender and bristle-like, and measure .006mm in length. The true cirrus bulb is .19mm in length and .11mm in breadth. It lies nearest that margin on which is the genital aperture, and in one of the sections extends to within .14mm of the anterior end of the segment. The same measurement was obtained from one of the segments in which the invaginated cirrus appeared in the shape of a loop.

The ovaries are two oval or elliptical organs, .17^{mm} long and .05^{mm} broad, lying one on each side of the median line at the posterior end of the segment. They appear to be confluent at the extreme posterior end of the segment. The granular elements of which they are composed measure .005^{mm} in diameter.

A thick-walled tube originates between the lobes of the ovary, and follows the region of the median line in a sinuous course to the posterior edge of the cirrus bulb. It then turns abruptly toward the margin, where it opens into the genital cloaca behind the cirrrus. This tube is evidently the vagina.

In some of the sections there are to be seen, near the vagina, what appear to be parts of a larger and convoluted tube. This I take to be the vas deferens. It differs radically in appearance from the vagina. The latter in longitudinal sections is linear; its thick walls inclose an empty space. The former is massive and filled with very fine striated material. This latter appearance, in sections of cestod segments, is occasioned by the presence of spermatozoa.

Along the margins of the segments, and in the interior among the other organs, there are numerous granular bodies. These are not always of definite shape, but are often elliptical, oval, or circular in section. They are probably sections of spheroidal masses. They are from .02 to .05^{mm} in diameter, and the granular nuclei with which they are filled are .003^{mm} in diameter. Some of these bodies, near the margins of the segment, had an incipient striated appearance. They are probably spermatic capsules of the testes, in the nuclear contents of which spermatozoa are beginning to be differentiated. There was no indication of ova in these segments.

TYLOCEPHALUM,* gen. nov.

[τύλος, a knob.]

Body articulate; head globose; bothria united into a globular disk and bearing four supplemental disks, which are arranged in lateral pairs; myzorhynchus also globose, as large as remainder of head. Neck, *i. e.*, unjointed anterior part of body, moderately long.

Genital apertures marginal (?).

I have found it necessary to establish this genus to accommodate a single small cestod from the spiral valve of the cow-nosed ray (*Rhinopterus quadriloba*). As the specimen was associated with a few specimens of *Rhinebothrium cancellatum*, I at first supposed that it might prove to be the young of that species. The total absence of anything like costæ, and, moreover, the presence of supplemental disks, at once shows that it can not be referred to either *Echeneibothrium* or *Rhinebothrium*.

* See foot-note on page 84.

The character of the head suggests a possible close relationship with *Discocephalum*. The large, globular myzorhynchus of *Tylocephalum* may be homologous with the broad, muscular head of *Discocephalum*, in which case the globular acetabular disk of the former would be homologous with the corrugated, inflated, cervical mass of the latter. If the acetabular disk of *Tylocephalum* were, in the adult, to divide into independent bothria, it would then exhibit a close resemblance to Van Beneden's *Discobothrium*.

Until more material is obtained the exact position of this Cestod must remain in some doubt.

20. *Tylocephalum pingue*, sp. nov.

[*Pinguis*, plump.]

[Plate IX, Figs. 5–9.]

Head divided into two spherical parts by a median transverse constriction, the anterior part a myzorhynchus, the posterior a bothrial disk, bearing four supplemental disks not evident in the living worm, but when the specimen is made transparent they are seen to be arranged in pairs, which are marginal with respect to the head, lateral with respect to the body.

Anterior segments begin some distance back of head, very short, much broader than long, subsequently squarish, ultimately longer than broad. Habit of body rather plump in subcylindrical. Genital apertures marginal (?). Length of immature specimen 20^{mm}.

Habitat.—Rhinoptera quadriloba, spiral valve, one specimen, Wood's Holl, Massachusetts, July 20, 1887.

The description of this genus and species is based on the examination of a single specimen. While no sexually mature segments exist the adult or strobile condition is well assured. I shall first give the description made of it while it was yet living, and then add the few observations I have been able to make after a study of the alcoholic specimens.

When the specimen was first found it was firmly attached to the mucous membrane about the middle of the spiral valve of its host. The anterior part of the head, or myzorhynchus, was imbedded in the mucous membrane. It was carefully removed without damage and the specimen placed in sea water. It then measured 20^{mm}. Its form was subcylindrical, and it had an arcuate outline on account of a flexure towards one of its margins. No movements were observed in it at first, and until it was examined with a lens it was taken to be a specimen of some *Echinorhynchus*.

The shape of the head was very peculiar, and totally unlike that of any cestod I had ever seen. In my notes made at the time I described it as shaped like a dumb-bell with a very short handle, the axis of the handle coinciding with the axis of the body. The anterior globular

part of the head, that part which was imbedded in the mucous membrane, when removed appeared to be more delicate than the posterior part. It was delicate and translucent, and of a faint pink or carnation color.

Behind the anterior tumid part of the head there was a constriction, making the handle of the dumb-bell. The band which formed this constriction was also pinkish in color. Behind this constriction was the second tumid part of the head, which was dense and opaque and of an ivory-white color. The color of the body was yellowish-white.

The head preserved its singular shape unchanged when placed in sea water, although the worm showed signs of life by very slow movements, especially of the posterior segments. The worm as a whole, however, was practically immobile, and in this respect was in sharp contrast with the very active movements of some specimens of *Rhinebothrium*, which were associated with it.

Following the head was a nearly cylindrical neck, which makes a slight but abrupt enlargement a little less than 1^{mm} back of the head. Transverse lines, which run from the margins towards the middle of the lateral faces, very soon make their appearance, but do not meet so as to divide the body into distinct segments until about 8^{mm} back of the head. The segments are at first quite short. Farther back they become squarish. Near the posterior end they are longer than broad. Four or five of the posterior segments, excepting the last one, had beautiful curving marginal outlines, being convex in front and concave behind. The last segment was considerably elongated.

The following measurements are from the living specimens:

	Millimeters.
Length	20.00
Length of head	1.16
Length of myzorhynchus	.58
Diameter of myzorhynchus	.76
Length of median constriction	.14
Diameter of median constriction	.56
Length of acetabular disk	.44
Diameter of acetabular disk	.74
Diameter of neck immediately behind head	.30
Diameter 1^{mm} back of head	.36
Length of median segments	.13
Breadth of median segments	.50
Length of segments near posterior end	.40
Breadth of segments near posterior end	.40
Length of last segment	.66
Breadth of last segment	.28

The habit of the body throughout is rather plump, inclining to cylindrical.

The specimen was further examined after it had lain some four months in alcohol. When placed in glycerine the anterior bulb of the head became transparent. Longitudinal muscular fibers could be seen enter-

ing it from behind and diverging in all directions to the periphery. The posterior bulb remained too opaque to show its structure. Immediately back of the head the neck was somewhat flattened for a short distance, beyond which it was rather plump and cylindrical. The short, flattened part of the neck was transparent, and within it could be seen a band of about ten longitudinal muscles or vessels, or both. There were no indications of reproductive organs.

The specimen was next examined in oil of cloves. The character of the head was now found to be quite different from what it had been supposed to be when studied in the living specimen. The anterior part proves to be a large globular and muscular myzorhynchus, which may possibly be retractile. The central constricted part of the head is distinct, and surrounds the compressed base of the myzorhynchus like a collar. The posterior part of the head is not strictly globular, but is longer in that diameter which corresponds to the marginal diameter of the body than it is in the opposite direction. It is entire in outline, undivided, and at its base surrounds the constricted neck like a collar. On its anterior surface it bears four supplemental disks. These are oval or oblong, in shape, and are directed forwards. They appear to be arranged in pairs, which are marginal with respect to the head, lateral with respect to the body. They are about .01^{mm} in diameter, cup-shaped, with depressed centers, in which there is a reticulated muscular tissue, and with raised edges which are composed mainly of radiating fibers.

The middle of the neck and anterior part of the body is traversed by a number of strong muscular bands of longitudinal fibers. These bands, or fascicles are distinct from certain broad sheets of longitudinal muscular fibers which can also be seen in this part of the body. The central band of fibers, or vessels, continues to be visible to the posterior end of the body.

The posterior bulb of the head is very muscular. The outer part of it is granular with radiating and circular fibers. Of these the radiating fibers predominate. Beneath this outer layer towards the center and the anterior part of the bulb there are numerous strong diagonal fibers crossing each other so as to make a net-work with rhombic meshes. The middle constricted part of the head is made up of granular tissue with very numerous radiating fibers, which enter from behind and diverge to the free collar-like border. Its center is composed of longitudinal fibers, which, entering the base of the anterior enlargement or myzorhynchus from behind, make the divergent longitudinal fibers which form the predominating fibrous tissue of that organ.

The head is thus seen to be made up of three parts: First, the myzorhynchus, which is globose in front, but contracts to a comparatively narrow base. The latter is surrounded by the anterior rim of the second part. This second or middle part of the head is short, separated from the posterior part by a deep furrow, and surrounds the base of the myzorhynchus with its anterior raised border. It may possibly be a

kind of terminal os into which the muscular proboscis can be retracted. The third part is a muscular disc, which bears four auxiliary acetabula on its anterior edge. It is truncate in front, globular in lateral, oblong in marginal view. At its base it forms a collar, with thick, rounded edges, which surrounds the abruptly-narrowed neck.

Anatomy of posterior segments.—The last three segments were stained with hæmatoxylon and cut into longitudinal sections. The segments are as yet too immature to allow one to say certainly that the genital apertures are marginal. There is, however, a dense, pyriform nuclear cluster towards the front end of each segment and nearer to one margin than the other, which I believe outlines the beginning of the cirrus bulb. There is also a nuclear aggregation at the base of each segment, which probably marks the beginning of the ovary. Although no external genital apertures as yet exist, I feel quite confident, from the appearance of these segments, that, when adult specimens of this species are found, the genital apertures will be found to be marginal.

The sections show first a soft, granular epidermis, which has a tendency to slough off. Next a fine granular layer containing delicate circular fibers. Beneath this is a layer with coarse granular and longitudinal fibers. The center of the segment is granular with no fibers of any kind. There are, however, many clusters of nuclei with a clear space in the center of the cluster. These are apparently sections of tubular bodies which are beginning to take shape in the parenchyma of the interior of the segment. Some of these nuclear clusters are elongated. Two rather prominent aquiferous vessels were observed. Each of these lies a distance from the nearest margin equal to nearly one-third the breadth of the segment. These pursued a somewhat sinuous course and passed without interruption from one segment to another.

The segments are sharply defined, the one from the other. At the dividing line between two segments an abundance of circular or transverse fibers is developed. The posterior edge of each segment projects a very little to overlap the front end of the succeeding segment.

Sub-family II.—Phyllacanthinæ *Van Beneden.*

Calliobothrium Van Beneden.

The restoration of Van Beneden's genus *Acanthobothrium* necessitates an emendation of the definition of the genus *Calliobothrium.* The characters of this genus, thus emended, following Diesing's definition, are:

Body articulate tæniæform; head continuous with the body or separated by a neck, quadrangular, with four angular bothria, which are attached to the head in front by the dorsal face, trilocular on account of two transverse costæ, each armed in front with four simple hooks, and provided in front of hooks with a versatile supplemental disk, cup-shaped, trilocular or contracted into a globe. Genital aperture marginal.

21. *Calliobothrium verticellatum* Rudolphi.

See Report of U. S. Fish Commission, 1886, pp. 476–479, Plate IV, Figs. 1–8, for description and synonymy.

I have already published a description of this Cestod, which I obtained in August, 1884, from the spiral valve of *Mustelus canis*.

Since then I have made several captures of this parasite in the same host.

Date of capture.	No. of dog-fish examined.	Number of parasites found and remarks.
1886.		
July 22	1	A single specimen.
23	3	Several in one, one in another, none in third.
24	4	Several in each.
31	1	Twenty specimens more or less, maximum length 154mm.
1887.		
July 19	6	Several from two of the hosts, maximum length 97mm.
21	10	Moderately abundant in all.
Aug. 4	3	Several obtained from each.
6	1	Three specimens, maximum length 115mm.
10	3	About a dozen from one, ten from another, none from third, 110mm maximum.
12	1	A few specimens much attenuated and flaccid.
13	2	About forty specimens in one, nine in the other.

I add the following data to my former account of this worm. The length of the adult strobile evidently far exceeds 100mm, the maximum of my former paper. The longest living specimen that I have measured was 154mm in length. I also find several alcoholic specimens measuring as much as 90mm in length. The free proglottides are much larger than the posterior segments of the specimens upon which I based my former description.

Following are measurements of posterior and free segments of alcoholic specimens:

	Millimeters	Millimeters.	Millimeters.	Millimeters.
Length of proglottis	5.6	4.6	3.6	5.4
Breadth of proglottis	1.3	1.4	2.2	1.3

In a living strobile, 115mm in length, the last segment, when at rest, measured 3.5mm in length and 1.75mm in breadth. Free proglottides in the same lot were very active, in some cases stretching themselves out to a length of 10mm.

The following points were made out without the aid of thin sections: The genital apertures are marginal, near, or in front of, the anterior third. There is sometimes a low papilla in the vicinity of the aperture. The cirrus is comparatively short, small and covered, at least at base, with exceedingly minute spines. It was not seen fully everted. Diameter

at base in one case about .03mm. The cirrus bulb in this instance small, nearly circular in outline, and .6mm in diameter. In one instance the cirrus was protruded about .044mm and measured .023mm in diameter. No spines were visible on the everted cirrus. In the posterior segments the ovaries occupy about the posterior fourth, and under moderate enlargement appear as finely granular organs, somewhat two-lobed, but confluent at the middle line. In segments which precede the extreme posterior ones the ovaries occupy as much as the posterior third, their anterior edge making a line transverse to the axis of the segment. The inner termination of the vagina is in a bulbous enlargement—seminal receptacle—between the lobes of the ovary. A wide duct or sinus, the uterus, occupies the median line of the segment from the ovary almost to the anterior end of the segment. The vagina leaves the uterus opposite the genital aperture and proceeds directly to the margin of the segment, thus making a right angle with the axis of the segment. The vas deferens is represented by a cluster of tubes at the anterior end of the segment. The remainder of the interior of these segments is filled with large, spherical, granular bodies, which I take to be the testes. In the mature free proglottides the anatomy is quite different from what has been given for the posterior segments. In the former an inner oblong space, the uterus, which is of considerable extent, becomes converted into an ovisac which is filled with small ova. Such a proglottis when rendered transparent in glycerine resembles a double sac. The tissue of the outer sac appears homogeneous, with the exception of a few small granular masses, which apparently represent the remnants of the testes and vas deferens. The inner sac is sharply defined from the outer by a thin limiting membrane and is filled with ova.

The foregoing points in the anatomy of the segments were confirmed by thin sections, and a few additional facts obtained. In longitudinal sections the cirrus was seen to be armed with minute spines throughout its entire length. Both the cirrus and its bulb are remarkably small in proportion to the size of the mature proglottis. The vagina was seen to open immediately in front of the cirrus. The vas deferens was found to be quite voluminous, and appeared in sections as convoluted vessels filled with a dense, filamentous substance, which I take to be spermatozoa. Some of the large, granular bodies already mentioned, were seen, in sections, to contain, besides the granular nuclei, abundant fibrous tissue. I have interpreted this as indicating the transformation of the nuclear contents of the testicles into spermatozoa. In some sections in which the uterus appeared as a broad median sinus with irregular outlines the vagina was seen to lie, not in the median sinus, but along one of its sides, within the dense, granular tissue which form the boundary walls of the sinus. This was about the middle of the segment. In some sections, however, which showed the posterior part of the segment, the vagina was seen as a convoluted tube between the lobes of the ovary, and appeared for a short time after leaving the ovary to lie in the median sinus.

The ova when highly magnified are seen to be oval and measure about .066^{mm} and .055^{mm} in the two diameters. Each ovum contained about a half a dozen globular masses, which are densely granular, stain deeply, and measure about .019^{mm} in diameter.

22. *Calliobothrium eschrichtii* Van Beneden.

[Plate VII, Figs. 5–12.]

Acanthobothrium eschrichtii Van Beneden, Bull. Acad., Belgique, XVI, II, 280.

Onchobothrium (*Calliobothrium*) *elegans*, Diesing, Sitz., der kais. Akad., XIII, 585.

Calliobothrium eschrichtii Van Beneden, Mém. Acad. Belgique, XXV, 142 and 193, Plate XIV; Diesing Revis. Ceph., Ab. Par. 280.

I have found a *Calliobothrium* repeatedly in *Mustelus canis*, which in most particulars agrees with Van Beneden's *C. eschrichtii* from *Mustelus vulgaris*. Van Beneden's description of this species is thus epitomized by Diesing:

Head subangular, bothria four, angular, subelliptical, each divided into three unequal loculi by two transverse costæ, armed in front by four simple subequal hooklets, and provided in front of hooklets with a supplemental disk (*auxiliary acetabulum*), which is sometimes simple, trilocular. Neck short. Anterior segments of the body subquadrate, subsequently longer than broad. Genital apertures marginal. Length 4 to 6^{mm}.

I find in my notes records of eight different captures of this species, each time in the spiral valve of the smooth dog-fish (*Mustelus canis*). All the captures were made at Wood's Holl, Massachusetts.

Following is a summary of the records:

Date of capture.	No. of dog-fish examined.	Number of specimens obtained and remarks.
1886.		
July 22	1	Eighteen.
23	3	Five in one host, near anterior end of spiral valve.
24	4	One in one of the four hosts.
Aug. 6	1	One.
1887.		
July 19	6	Two from one of the six hosts.
21	10	Six found in a few of the ten hosts.
Aug. 10	3	Eleven from one of the three hosts.
13	2	Two from one, and one from the other host.

These specimens were almost invariably associated with *C. verticillatum*, *Rhynchbothrium bulbifer*, and *R. tumidulum*. The same host was examined on twelve other occasions in the latter part of July and fore part of August without finding this parasite.

The length of the specimens which I have obtained varies from 5 to 14^{mm}. The average of nine specimens from the capture of July 22, 1886, is 9.56^{mm}, maximum, 14^{mm}; minimum, 6^{mm}.

The following detailed measurements were made on living specimens:

Dimensions.	No. 1.	No. 2.
	mm.	*mm.*
Length	9.00	6.00
Length of head	.....	.90
Length of bothria from hooks to posterior end	.60	.64
Breadth of bothria	.....	.34
Length of hooks	.20	.24
Diameter of neck	.20	.24
Length of last segment	1.00	1.00
Breadth of last segment	.60	.32

In No. 1 there were six large proglottides preceded by five smaller ones and a few indistinct ones near the head. In No. 2 there were fifteen distinct segments. The first six or eight of these were only moderately distinct, merging into fine transverse wrinkles near the head. In another specimen the five posterior segments were larger than the others and were preceded by nine smaller segments, gradually diminishing towards the head, where they merged into indistinct segments, indicated by transverse lines. The posterior segments are, in general, elongated, loosely attached to each other, and separating easily from the strobile. Usually there are from three to five mature segments. Six is the greatest number observed on a single strobile.

The greatest difference observable between these specimens and Van Beneden's *C. eschrichtii* is in respect to the dimensions of the posterior segments. The dimensions given by Van Beneden for *C. eschrichtii* are: Length, 4 to 5^{mm}; length of bothria, .6^{mm}; length of hooks, .1^{mm}; breadth of neck, .2^{mm}; length of free proglottis, 8 to 9^{mm}. A comparison of these measurements with those given above will show that the principal difference is that which exists between the posterior segments of my specimens and the free proglottis of Van Beneden's description.

On one occasion I found a large proglottis associated with some individuals of these species which I at first thought might prove to belong to *C. eschrichtii*. Upon comparing it carefully with posterior segments of *C. eschrichtii* and of *Rhynchobothrium bulbifer* I found that it belonged to the latter. I am therefore tempted to believe that Van Beneden has mistaken the free proglottis of some other Cestod for that of *C. eschrichtii*. I have frequently found mature segments on the longer strobiles of *C. eschrichtii*, as well as free proglottides, from which the large ova were issuing, but have never found them to exceed about 1.5^{mm} in length, while on the other hand, associated with them, I have often found specimens of *R. bulbifer* with posterior segments and free proglottides measuring 5^{mm} and 6^{mm} in length.

The description given above is perhaps enough to render identifications of this species certain, but as Van Beneden's description would indicate that there may be some constant differences between his speci-

mens and these which were obtained on this side of the Atlantic, I add the following data:

The head at rest is somewhat rectangular in outline. The bothria, four in number, are opposite, that is, not arranged in marginal pairs, oblong, rather bluntly rounded posteriorly, hollowed out on the face, boat-shaped. They are divided into three loculi by two transverse costæ. The two posterior loculi are of nearly equal length and shorter than the anterior one. At the anterior end each bothrium bears four simple hooks. These are in pairs, a pair near each margin. The bases of the hooks in each pair are closely articulated, but do not spring from a common base. The hooks are relatively long and slender, pointing backward. They curve outward slightly at first, but near the points return until they are nearly parallel with the axis of the head. The outer hook of each pair (outer with reference to bothrium) is a little longer and more slender than its mate. The inner hooks have very broad subcutaneous basal supports; a prolongation of each approaches that of the other and almost meets it. There seems, indeed, to be a small solid piece which fills up the interval between the bases. Muscular fibers can be traced to the basal supports of all the hooks. The hooks themselves when magnified are seen to be hollow and filled with finely granular material. The combined effect of these hooks is to form a crown of sixteen hooks.

In front of the hooks each bothrium is surmounted by a triangular pad which bears a single supplemental disk. This part of the bothrium is capable of considerable variation in shape. I have seen it approach the trefoil shape figured by Van Beneden, but have never seen it assume that shape definitely.

The posterior ends of the bothria are free and are susceptible of much variety of motion. In progressive movements the bothria are thrust forward either by diagonally opposite pairs, by adjacent pairs, or singly. When a specimen was placed under a compressor and slight pressure applied a bothrium was pushed forward in front of the head and attached to the cover-glass by the supplemental disk and the posterior loculus. By this means the head was dragged forward. The last part to detach itself from the cover-glass was the posterior loculus, which was acting as an independent sucking-disk. In ordinary progression the entire face of the bothrium is attached to the supporting surface. The head of the living worm is almost transparent. The bothria are strengthened by bands of muscle fibers, which lie near the margins at the bottom of the trough-like face and send up short branches to the upper edge or rim. Each bothrium is further strengthened by two transverse muscular bands, which form the characteristic costæ. A single bothrium in the living worm suggests a wire flower basket. When the posterior ends of the bothria are reflexed they are seen to be joined to the head by a broad membrane, in which lie bands of muscular fibers. When the bothria are reflexed sufficiently, that is, when their posterior

ends are turned outward and forward over the hooks, as is often the case in active worms, a short neck is revealed, which is cylindrical and lightly tumid just back of the point of attachment of the bothria. The neck or anterior part of the body is very elastic and in life contracts and expands constantly. Transverse striæ appear very soon and segments make their appearance soon after the striæ begin. A few of the first segments are broader than long. These are followed by a few which are as long as broad. The subsequent segments are longer than broad. The posterior segments are usually several times as long as broad; occasionally they are contracted until they are nearly as broad as long, often with narrow extremities.

Genital apertures marginal, about posterior third. Cirrus long and, so far as observed, smooth; vas deferens long and much convoluted. Vagina a slender tube opening in front of cirrus. Ovaries two oblong lobes lying on either side of the median line, confluent at posterior end of segment and occupying nearly the posterior third of the length of the segment. The ova are relatively large. They were frequently seen issuing from the ruptured walls of mature segments which had lain for a few hours in sea water. They are globular in shape and consist of a granular center surrounded by a thick but perfectly transparent envelope, with a very thin limiting membrane. In some the granular interior appeared to be undergoing segmentation. This segmented interior in some of the ova had assumed a stellate shape on account of prolongations of its substance, which penetrated the surrounding envelope. These prolongations were generally knobbed at the ends. Measurements of several ova which had escaped from a mature segment and had been lying for some time in water gave the following results:

	Longer diameter.	Shorter diameter.
	Mm.	*Mm.*
1	0.32	0.26
2	0.24	0.20
3	0.26	0.22
4	0.26	0.26
5	0.18	0.16

The ova evidently increase in size after being discharged from the segment, by the imbibition of water through the investing pellicle.

Van Beneden describes and figures the ova of *C. eschrichtii* as having very long filamentous appendages. While I have never seen any appearance of that kind in the ova of my specimens there does not seem to be anything inconsistent with it. The thick transparent envelope which surrounds the granular or nuclear interior might assume under certain conditions of contraction very diverse shapes.

It will be seen by the foregoing description that there are some im-

portant differences between these specimens and *C. eschrichtii.* The points of resemblance are so many, however, that I do not feel justified, at present, in making a new specific name.

ACANTHOBOTHRIUM Van Beneden.

Bothriocephali (*Onchobothrii*) spec., Rudolphi.
Calliobothrii spec., Diesing.

Body articulate tæniæform. Head separated from the body by a neck, quadrangular. Bothria four, opposite, attached to head by antero-dorsal side, each with two transverse costæ on face, and armed in front with two bifurcate hooks, and surmounted in front of hooks by a triangular pad, bearing a supplemental disk which is capable of assuming diverse forms. Genital apertures marginal.

The genus *Acanthobothrium* was established by Van Beneden to accommodate forms whose scolices resemble those of *Calliobothrium*, but which bear forked instead of simple hooks. To the genus *Acanthobothrium* he referred the species *A. coronatum* (*Bothriocephalus coronatus* Rud.), and a species which he named in honor of Dujardin, *A. dujardinii.* The former species has since been referred to the genus *Calliobothrium* by Diesing, whose classification is accepted by Von Linstow. Van Beneden's species, *A. dujardinii*, is placed in a new genus by Diesing, and is now known as *Prosthecobothrium dujardinii.*

The genus *Acanthobothrium* is thus briefly characterized by Van Beneden:

The four bothria armed each with two hooks united at their base and forked at the apex.

I have been led to restore the name *Acanthobothrium* on account of a small species, the scolex of which agrees very closely with *A. coronatum*, and the strobile with *A. dujardinii* Van Ben. (*Prosthecobothrium dujardinii* Dies.). According to this view the species *C. coronatum* should be henceforth known as *Acanthobothrium coronatum* Rud.

Acanthobothrium paulum, sp. nov.

[Plate VIII. Figs. 1–7.]

Head subquadrate. Bothria four, opposite, oblong, faces hollowed out and boat-shaped, borders usually somewhat inflexed, with two transverse costæ, the anterior costa a little back of the middle of the bothrium, the other near the posterior end. The posterior ends of the bothria from about the anterior costa free and versatile, narrowed and bluntly rounded, each bothrium with two forked hooks at anterior end. The bases of these hooks meet on the median line of the bothrium. The inner prongs are the longer, the distance between them is about equal to the distance between two prongs of the same hook. The outer prongs bend outwards and backwards sharply. The bases of the hooks are slender, about same diameter as the prongs, and are not quite as long

as the shorter prong. They join by a simple articulation. In front of each pair of hooks is a triangular pad which bears a single, circular, supplemental disk. The neck is rather long and merges imperceptibly into the segmented body. The first segments are broader than long, but increase in length uniformly. The median segments are squarish, posterior segments longer than broad, slightly irregular in outline. In all specimens thus far observed the posterior segments are from four to eight times as long as broad. In most of the specimens, especially the shorter ones, the last segment is attenuated at the posterior end.

Genital openings marginal, near the middle of the segment. Cirrus very long when fully extended, bulbous at base when partly everted, densely echinate. Length, maximum 20mm.

Habitat.—Trygon centrura, spiral valve, July, 1886; August, 1887. Wood's Holl, Massachusetts.

I have obtained this parasite on four different occasions from the spiral valve of the sting ray (*Trygon centrura*). Following is a brief summary of the different captures:

July 29, 1886; about thirty specimens from spiral valve of one ray. longest specimen about 20mm.

August 1, 1887; four specimens obtained from a lot of three rays; longest specimen about 9mm.

August 8, 1887; about two hundred and fourteen specimens; all quite small; maximum about 5mm, from a single ray.

August 10, 1887; five specimens; maximum 13.5mm, from two rays. Three of these specimens, maximum 13.5mm, had black hooks. The remaining two, maximum 6mm, had the ordinary amber-colored hooks. The black color, however, disappeared from the former when the specimens were placed in alcohol.

The following measurements, with the exception of the hooks of one or two specimens, were made from living specimens:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*
Length	19.00	9.00	4.50	13.50	6.00
Length of head	.....	0.60	.....	.....	.....
Diameter of head at hooks	.....	0.26	0.26	0.30	0.42
Length of bothria	0.80	.....	0.50	0.80	0.64
Breadth of bothria	0.24	.....	0.12	0.20	0.18
Length of hooks, maximum	0.20	0.18	0.14	0.16	0.16
Length of single prong, maximum	0.14	0.13	0.10	0.10	0.12
Diameter of neck	0.24	0.10	0.10	0.08	0.18
Length of neck	1.40	1.00	0.80	1.00	0.70
Length of first distinct segments	0.06	0.06	0.04	0.03	0.05
Breadth of first distinct segments	0.16	0.14	0.12	0.14	0.24
Length of posterior segments	1.40	1.60	0.68	1.50	1.06
Breadth of posterior segments	0.20	0.26	0.18	0.20	0.24

There is some difference between the larger specimens, 15 to 20mm in length, and the smaller specimens, 4 to 6mm in length, besides a difference in size. This difference, however, is confined to the region of the posterior segments, where considerable variety is to be expected in

specimens of different ages. The hooks in the smaller specimens are relatively longer in proportion to the length of the bothria than is the case in the larger specimens. In the smaller specimens the posterior segments are slender, somewhat fusiform, tapering slightly towards anterior end, more decidedly towards posterior end. In the larger specimens the posterior segments are in general linear oblong. If these differences should be found to persist in specimens with ripe proglottides they should be separated into different species.

The most conspicuous organ of the posterior segments is the cirrus. It is near the middle of the segment, and, when retracted, lies as a prominent pyriform or fusiform body near the median line. It may be seen to be densely covered with spines in specimens placed in glycerine. In specimens which measured not more than 4^{mm} in length and contained only from sixteen to twenty distinct segments the cirrus could be distinguished in the last eight or ten segments. In one of the larger specimens, about 16^{mm} in length, one of the posterior segments .9^{mm} long and .36^{mm} broad, somewhat flattened, the cirrus is unrolled until it is nearly as long as the segment. The spines in this instance are nearly all lost, a few patches of epidermal tissue bearing slender spines adhere to its surface. In some cases the pyriform basal part of the cirrus is protruded, and can be seen to contain the remainder of the cirrus coiled up in the interior. The spines on the basal part of the cirrus are short triangular, with broad bases and acuminate points. They are about .005^{mm} in length and .004^{mm} in breadth at base. The remaining spines are very slender, about .007^{mm} in length and .0005^{mm} in breadth.

In one segment I observed what appears to be the extremity of a very slender vagina protruding as a vulva from the margin immediately in front of the cirrus. The length of this segment was .8^{mm}, its breadth .36^{mm}; length of cirrus .8^{mm}; diameter at base .08^{mm}; at apex .018^{mm}. The vulva protruded .035^{mm} from the margin of the segment, and was at first .008^{mm} in diameter, enlarging to a funnel-shaped extremity .035^{mm} in diameter.

No ova were found in any of the segments. The interior of the posterior segments is filled with the spherical spermatic capsules of the testes, about .03^{mm} in diameter.

When sufficiently magnified, several bundles of longitudinal muscles can be seen in the neck near the head. A specimen that had been killed by flattening between two slips of glass and immersing in alcohol was stained with carmine, and then mounted in Canada balsam. By this means the bundles of longitudinal muscles are well differentiated. Of these there are eight; four larger median, and four smaller, the latter arranged two on each margin.

These bundles are distributed to the bothria and the anterior triangular cushions which bear the supplemental disks. Longitudinal, transverse, and diagonal muscular fibers can be distinguished in the bothria. Their arrangement can not be made out, however, on account

of the distortion resulting from compression. Behind the hooks the bothria contain a great many circular fibers, which are arranged concentrically, with the hooks as a center. Some of these concentric fibers are attached to the base of the hooks. Other fibers, also attached to the base of the hooks, cross the circular fibers radially and extend back through the bothria parallel with their long axis. Both of these sorts of fibers are exceedingly delicate. The circular muscles evidently effect the motion of circumduction or rotation in the hooks, while the radial muscles effect the motions of abduction and adduction respectively. Short, blunt processes on the under side of the hooks afford means of attachment for the muscles. These processes are on the under side of the inner prongs of the hooks. In this compressed, stained specimen the pads or cushions, which bear the supplemental disks, are emarginate posteriorly and have therefore a cordate shape. The supplemental disk measures .07^{mm} and .06^{mm} in its two diameters, inside measurement. The largest bands of muscular fibers in the neck are .048^{mm} broad, a single fiber measuring as much as .004^{mm} in breadth. The bundles of fibers in the neck can be seen plainly in specimens which have not been compressed. They are usually sinuous or waving in outline.

The smaller specimens have many characters in common with Van Beneden's *Acanthobothrium dujardinii* (*Prosthecobothrium dujardinii* Dies.), but as Van Beneden describes and figures that species as having the bothria destitute of transverse costæ, and, moreover, each provided with a posterior versatile flap, there can not be even a generic identity established between the two species. If Van Beneden's species had been based on alcoholic specimens one might suppose that he had mistaken the posterior fossette for a posterior appendage; I have seen such a deceptive appearance as this in a few alcoholic specimens. This consideration is hardly admissible, however, as Van Beneden mentions the extraordinary versatility of this posterior flap in active worms.

A. paulum differs from *A. coronatum* principally in its very much smaller size and in the different proportions of its segments.

Phoreiobothrium Linton.

24. *Phoreiobothrium lasium* Lt.

Report of U. S. Fish Commissioner, pp. 474–476, Plate iv, Figs. 24–29.

I encountered this parasite twice in the summer of 1887 at Wood's Holl, Massachusetts, each time in the dusky shark (*Carcharias obscurus*). The first lot, collected July 25, contained nine specimens, two of them small; the second lot, collected August 12, contained fourteen specimens. Since the description which I have given for this species was based on alcoholic specimens, I add the following data obtained from living specimens:

One specimen had the following dimensions while living: Length, 32^{mm}; length of bothria, .48^{mm}; breadth, .26^{mm}; length of hooks, longest

prong, .14^{mm}; diameter of head in front, .48^{mm}; at posterior end, .62^{mm}; diameter of neck, .13^{mm}; distance to first segment, .8^{mm}; length of segment, 10^{mm} from head, .16^{mm}; breadth, .16^{mm}; length of last segment, 1.28^{mm}; breadth, .42^{mm}; number of distinct segments, sixty. The specimen was slightly flattened under the compressor.

Another specimen of the same lot was 35^{mm} in length; its last segment 1.12^{mm} in length and .5^{mm} in breadth.

The proportions of the living worm do not differ materially from those of alcoholic specimens. It was observed, however, that after they had lain for twenty-four hours in sea water the specimens were not so straight nor symmetrical as at first. The apparent varieties in preserved specimens are evidently due to different degrees of contraction. The minute epidermal spines were found in isolated patches on several of the specimens.

PLATYBOTHRIUM, gen. nov.

[πλατης, broad.]

Body articulate, tæniæform. Head decidedly flattened, squarish, or trapezohedral. Bothria four, subtriangular, sessile arranged in marginal pairs, armed with compound hooks, and each terminating posteriorly in a cup-like depression or loculus. A single indistinct circular depression (supplemental disk ?) on each bothrium in front of hooks. Genital apertures marginal.

A single specimen furnishing, as I suppose, the type of a new genus, with some characters which ally it to *Prosthecobothrium* Dies., from the spiral valve of the dusky shark (*Carcharias obscurus*), presents such decided differences from any genus included in Diesing's Revisions that I am obliged, for the present, to describe it under a new generic name. In the flattened head and marginal pairs of bothria it is unique among the armed *Phyllacanthinæ*. An objection to referring the specimen to the genus *Prosthecobothrium* is that the apparent homologue of the posterior bothrial appendage which is characteristic of that genus is, in this specimen, to be regarded rather as a loculus formed by a transverse costa near the posterior end of the bothrium, or as a kind of posterior cupping disk. Further, there is a faint indication of a single supplemental disk on each bothrium in front of the compound hooks.

Again, the doubtful character of the supplemental disk, the single or no transverse costa, and the character of the hooks exclude the genera *Calliobothrium*, *Acanthobothrium*, and *Onchobothrium*. The flattened bothria and their arrangement in marginal pairs exclude the problematical genus *Cylindrophorus* as well as *Phoreiobothrium*.

25. *Platybothrium cervinum*, sp. nov.

[Plate VIII, Figs. 8–10, and Plate IX, Fig. 1.]

Head quite flat, squarish, rhomboidal or irregularly hexagonal in outline, in lateral view; thickness less than half the breadth. Bothria

four, subtriangular in closely appressed marginal pairs. When seen from the lateral side the two bothria, which are then in view, resemble right triangles with their acute angles truncated, and so placed with reference to each other that the hypothenuses are parallel and separated by a narrow space along the median line of the head. The shorter legs of the triangles then form the antero-lateral boundary of the head and the longer legs, the postero-lateral boundary. The truncated acute angles form the apex and base of the head, respectively. There appears to be a faint supplemental disk near the anterior end of each bothrium in front of the hooks, although its identification in the alcoholic specimen is not altogether satisfactory. At the posterior end of each bothrium there is a highly characteristic modification, the exact nature of which I am not sure that I understand. In the sketches made of the living worm it appears to be a transverse costa, which is convex toward the front, lying near the posterior end of the bothrium and making a loculus in the face of the bothrium. In the alcoholic specimen, however, the appearance is somewhat different. Each bothrium appears to become somewhat tubular at its posterior extremity, and what, in the living specimen, appeared to be a posterior loculus, now seems to be the thickened tubular end of the bothrium. The inner boundary of this tubular end extends farther back than the outer boundary, so that the appearance in a specimen which had been slightly compressed would, of course, be the same as if the bothrium were crossed by a transverse costa near the posterior end. The faces of the bothrium are but little hollowed out.

Each bothrium bears near its anterior border a very characteristic set of compound hooks. The hooks showed with perfect distinctness through the transparent tissues of the head. The system of hooks on each bothrium is in three distinct parts, all of which are joined together. The arrangement of the hooks is shown in the sketches of the head. It is, in brief, as follows: Two hooklets, or rather the two prongs of a single hook, terminate the system on the inner side of the bothrium. These inner prongs are long and slender, directed backward, and lie close beside the corresponding pair in the other lateral bothrium. These prongs are terminal forks of a slender, arcuate bar, which is convex in front and articulates by means of an overlapping joint with a short, slender process, which, in turn, articulates by a plain hinge-joint with the basal prolongations of the outer set of hooklets at the marginal angle of the bothrium. This latter cluster appears at first sight to consist of three hooklets. There are in reality but two. These, like the inner hooklets, are forks of a basal part. They are long and slender, recurved, and a little larger than the inner pair. The basal part of the outer hooklets sends back a subcutaneous prolongation, which, on account of the transparency of the soft tissues of the head, looks as if it were a third prong of the compound hook. It can be easily proved to lie beneath the external coat of soft tissue. The hooklets are hol-

low, as are also the basal supports and, in fact, the whole system, with the exception of the short bar which connects the long basal support of the inner set with the shorter prolongations of the outer set.

The neck is very long and slender. No distinct segments occur until 25mm or 30mm back of the head. The first segments are squarish; the succeeding segments increase in length slowly; median segments square, becoming subcircular in outline, and towards posterior end elongated; last segments three or four times as long as broad and in life somewhat cylindrical.

Genital apertures marginal, near middle of segment, male and female approximate. Length 67mm.

Habitat.—Carcharius obscurus, spiral valve, a single specimen. Wood's Holl, Massachusetts, August 12, 1887.

The following measurements were made on the living specimen held in place by slight compression:

Length, 67mm; length of head, .52mm; greatest diameter of head, .54mm; diameter in front of hooks, .20mm; diameter, posterior, .24mm; thickness of head, .24mm; greatest breadth of single bothrium, .26mm; length of hooks, .16mm; lateral diameter of neck, .08mm; marginal diameter, .06mm; length of neck, about 16mm; length of first distinct segments, .10mm; breadth, .26mm; length of postero-median segments, .60mm; breadth, .36mm; length of last segments, 1.40; breadth, .40mm.

With regard to the occurrence of supplemental disks in this species I am in some doubt. When the living worm was first examined the sketch which my wife made of it showed that the anterior ends of the bothria were somewhat elongated and rounded, with a circular depression showing plainly in each. When I examined the specimen an hour or two later, in order to obtain measurements, the anterior ends of the bothria were abruptly truncated and there was no sign of circular depressions. Afterwards, when the worm, as an alcoholic specimen, was transferred to glycerine, something like supplemental disks were faintly visible. These are circular and about .033mm in diameter. It would appear that the anterior ends of the bothria contract or fold inward, thus obscuring the faint depression, which is probably to be regarded as a supplemental disk.

When the posterior segments were flattened out in glycerine they appeared quite regular in outline, rectangular, and somewhat confluent, so as to give to the margins of the strobile in places a gently undulating outline. None of the segments are mature. The posterior segments are filled with granular bodies about .03mm in diameter. These bodies are globular in shape in the anterior part of the segment. In the posterior part of the segment they are more irregular and collected into large elongated masses. These granular masses extend to the extreme posterior edge of the segment, while at the anterior end there is a space of clear, finely granular tissue, which extends backward along each margin between the central granular masses and the external cuticular layer.

Two of the posterior segments were stained with red and green aniline and a few additional points in the anatomy were made out. The vagina was traced from the posterior end of the segment along the median line in a straight course to about the anterior third, where it turned toward one of the margins, then back a little, and opened beside and in front of the cirrus, which, retracted in its bulb, lay in the bend of the vagina.

The cirrus bulb is oblong and apparently constantly angled or bent about the middle. That is, the cirrus bulb, from the marginal aperture, is inclined inward and backward. At about half its length it turns so that the inner end is inclined inward and forward. The length of the cirrus bulb, in one of the posterior segments, is about .22^{mm}; its diameter .055^{mm}.

When the segments were cleared up in oil of cloves the ovaries became visible at the posterior end, lying one on each side of the median line and separated from each other by the vagina, which at this point was somewhat enlarged.

THYSANOCEPHALUM, gen. nov.

Phyllobothrium, spec. Linton.

Body articulate, tæniæform. Head separated from body by neck, very small, quadrangular, with four sessile bothria, each armed with two simple hooks and provided with a single loculus in front of hooks. Neck at first slender, then expanding into a voluminous mass of lobed and crisped folds. Genital apertures marginal.

I was led into error in my original description of the Cestod upon which this genus is founded by its singularly close resemblance to Van Beneden's *Phyllobothrium lactuca* (Vers. Cestoïdes, Plate iv, Figs. 1–7). What was taken to be a rostellum, and so described by me, was present only in the smaller specimens of the lot. This so-called rostellum proves, upon subsequent examination, to be the true scolex. The sketches of this organ (see Notes on Entozoa, U. S. Fish Commission Report for 1886, Plate II, Figs. 7, 7*a*, and 7*b*) are misleading, particularly with regard to the hooks. The scolex is very small in comparison with the cervical ruff which follows it and which increases in size with the age of the strobile, while the scolex of the adult is no larger than that of young specimens.

26. *Thysanocephalum crispum* Lt.

Phyllobothrium thysanocephalum Lt., Report of U. S. Commissioner of Fish and Fisheries, 1886, pp. 464–468, Plate II, Figs. 1–12.

Scolex very small, minute when compared with the cervical ruff or pseudoscolex of an adult specimen, quadrangular in outline and provided with four oblong bothria. Each bothrium is divided about the anterior third into two loculi by a thick, transverse, chitinous (?) parti-

tion, which bears at each of its extremities a short, straightish hook. The posterior loculus is long-elliptical with irregular borders. The anterior loculus is nearly circular, with thick and nearly entire borders. The tissue of the sides and bottoms of these loculi is dense and firm. The neck immediately behind the scolex is slender, short, and cylindrical. It expands abruptly into a large, lobed, crisped, and folded mass, which, in alcoholic specimens, is more or less globose, but in living specimens may spread out into a flat, suctorial organ with fimbriated edges. This organ is so conspicuous and takes the place of bothria so effectually, particularly as the scolex appears to be missing in the larger specimens, that it may be called, with some degree of propriety, the pseudoscolex. The ratio of the diameter of the pseudoscolex to the true scolex may be from five to one, in young specimens, to thirty or more to one in adult specimens.

Behind the pseudoscolex the body is slightly flattened and longitudinally rugose. The unsegmented portion of the body is long, the segments appearing at first as transverse wrinkles, subsequently the segments decrease slightly in breadth and increase slowly in length. Near the posterior end they become squarish and at the extreme posterior end two or three times as long as broad. The ripe proglottides are easily detached and continue active for a long time after removal from the host.

Genital apertures marginal, approximate, cirrus long.

Length of strobile as much as one meter; breadth of pseudoscolex up to 15^{mm}; free proglottides as much as 8^{mm} long and 4.5^{mm} broad.

Habitat.—Tiger shark (*Galeocerdo tigrinus*), adult, half-grown, and young specimens together in spiral valve, July 23, 1885, Wood's Holl, Massachusetts.

Family IV. TETRARHYNCHIDÆ.

Subtribe *Trypanorhyncha* Diesing.

Subfamily *Phyllorhynchinæ* Van Beneden.

Subfamily I. DIBOTHRIORHYNCHINÆ.

Family *Dibothriorhynchidæ* Dies.

RHYNCHOBOTHRIUM Rudolphi.

Tetrarhynchus of authors.

Body tæniæform. Neck tubular. Head continuous with neck, with two opposite bothria, parallel or converging at the apices, lateral or marginal, entire or undivided, or, either bilocular with a longitudinal partition, or bilobed or divided. Proboscides four, terminal, filiform, armed, retractile in the neck, for the most part longer than the head. Genital apertures, male marginal, female lateral, or male and female marginal approximate.

27. *Rhynchobothrium bulbifer* Lt.

[Plate x, Figs. 8 and 9, and Plate xi, Figs. 1 and 2.]

Rhynchobothrium tenuicolle Rud., Lt., Report of U. S. Fish Commissioner for 1886, pp. 486–488, Plate v, Figs. 17 and 18.

Since publishing my first notice of this parasite, I have encountered it on several different occasions in the same host in which I first found it, viz, the smooth dog-fish (*Mustelus canis*). A careful revision of the subject in the light afforded by this additional material has convinced me that I was mistaken in referring this species to *R. tenuicolle*. I have, indeed, found it necessary to make a new specific name to accommodate it.

The species *R. bulbifer* may be briefly described as follows: Bothria two, suborbicular, but somewhat variable, with a raised and rather thick border, emarginate on posterior edge, more or less approximate in front, divergent posteriorly. The head in marginal view is therefore sagittate. Neck long, slender, subcylindrical, tapering gently for a short distance back of the head, then increasing in diameter slightly to the contractile bulbs. Immediately behind the bulbs there is a constriction, distinct in some, slight in others, behind which the neck enlarges to form a rounded or even globular base which is separated from the body by a profound constriction. The body behind this constriction is slender, subcylindrical, and for some distance is without segments or transverse markings of any kind. The first segments are rather faintly outlined; they are squarish, or even a little longer than broad; the segments increase in length towards the posterior end; the posterior segments are very large, three to four times as long as broad, rounded at the two extremities, held together feebly by narrow commissures, separating easily from the strobile. Free proglottides very active and apparently continue to grow after their release from the strobile. Proboscides very long, slender, and graceful, armed with hooks of different shapes. Proboscis sheaths slender, spiral; bulbs linear, oblong. Genital apertures marginal, usually indicated by a broad, square notch about the posterior third of the segment. Entire strobile lanceolate, with finely serrate margins and few, rarely as many as twelve, segments.

Length, 20 to 40^{mm}; length of free proglottides as much as 12^{mm}.

Habitat.—*Mustelus canis*, spiral valve, of frequent occurrence, July and August, Wood's Holl, Massachusetts.

Following is a list of the captures of this worm :

Date of capture.	No. of Dog-fish examined.	Number of specimens obtained and remarks.
1886.		
July 22 ...	1	Three, and free proglottides.
23 ...	3	Twenty, and free proglottides with dark colored ova.
24 ...	4	Several.
31 ...	1	Twelve.
1887.		
July 19 ..	6	Several in each.
21 ...	10	Abundant in each.
23 ...	1	Eight.
Aug. 4 ...	3	One.
6 ...	1	Two.
10 ...	3	Twelve, eleven from one host.
11 ...	2	Few.
12 ...	1	Two proglottides in bad condition.
13 ...	2	Five, two from one host, three from the other.

These specimens were associated in most cases with *R. tumidulum*, *Calliobothrium verticillatum*, and *C. eschrichtii*.

In the alcoholic specimen, of which I gave detailed measurements in a former paper, the entire length was 31^{mm}, and the length of the last segment 3^{mm}. I have since measured living specimens which differed little from the alcoholic specimens, except in the dimensions of the last segment. In one specimen, which measured 23^{mm} in length, the last segment was 3.5^{mm} in length, and a free proglottis 6^{mm} long and 2^{mm} broad. In another lot two strobiles yielded the following measurements: Length of one, 27^{mm}; length of last segment, 7^{mm}. Length of the other, 38^{mm}; length of last segment, 8.5^{mm}. Free proglottides were associated with these, which were as much as 10^{mm} and 12^{mm} in length. These are extremely active and evidently continue to grow after they have separated from the strobile.

The following detailed measurements were made of an alcoholic specimen: Length, 20^{mm}; length of head, .44^{mm}; diameter of head, .50^{mm}; diameter of neck, near head, .24^{mm}, middle .20^{mm}, base .30^{mm}; length of head and neck, 1.60^{mm}; distance to first distinct segments, 7^{mm}; length of first segment .60^{mm}, breadth .60^{mm}; length of last segment 3.7^{mm}, breadth .90^{mm}; length of proboscis 1.80^{mm}, diameter .04^{mm}.

The diameter given for the head is from the base in marginal view of strobile; the corresponding diameter in lateral view of strobile was .40^{mm}; the diameter of head near the apex is .34^{mm} in both views. In my former account of this parasite there is a typographical error on page 488, where the diameter of the proboscis should read .033^{mm} instead of .33^{mm}.

Arrangement of hooks on proboscides.—The figures published in this and the former paper give different views of the proboscides in this

species. There seems to be a considerable degree of diversity in the hooks on different sides and in different parts of the same proboscis. In general there appear to be three different styles of hooks. One kind is very minute, while of the larger and more conspicuous hooks one sort is broad and abruptly recurved, the other long and slender. The broad hooks are about .008^{mm} long and .006^{mm} wide at the base, maximum. They resemble pruning-hooks with short, stout blade. The long, slender hooks are of two kinds, one with an abruptly recurved apex, the other uniformly arcuate, tapering gradually to an acute point. The length of the long, slender hooks is about .016^{mm}, breadth at base .0027^{mm}. The arrangement of the small hooks at one point is shown in Fig. 1, Plate XI.

The distribution of the hooks appears to me to be somewhat in this wise: There is first a longitudinal series of short, broad hooks, apparently in two double rows, flanked on either side by a series of long, slender hooks with recurved points and arranged side by side in groups of three; the two latter series are separated from each other on the side of the proboscis opposite the short, broad hooks by a series of slender, arcuate hooks with other minute hooklets interspersed. Of the latter there are two longitudinal rows on either side of a row of the large arcuate hooks. Each hook in the latter row has a small hooklet situated near its base on the posterior side.

Anatomy of mature segments.—The following data were obtained from stained sections and from segments stained with carmine, hæmatoxylon, green, and red aniline respectively, and studied entire. The best results were obtained from an almost mature proglottis which had been flattened between two cover glasses, killed while in that position, stained with Beale's carmine, made transparent in oil of cloves, and studied entire. This segment was long, oval, somewhat slipper-shaped, length 6^{mm}, breadth 2^{mm}. The reproductive opening was marginal a little in front of the posterior third. The greater part of the interior was filled with roundish, granular bodies from .08 to .12^{mm} in diameter. These, when highly magnified, are seen to consist of a thick coat of dense fibrous tissue, inclosing a nest of nuclei or small granules. Behind the ovaries these granular bodies are more elongated and more closely crowded. These granular bodies, at least those which occupy the central parts of the proglottis, I take to be the spermatic capsules of the testes.

The ovary is situated near the posterior end of the proglottis and consists of two finely granular lobes, which are separated along the median line for the greater part of their length, but are confluent behind. They are surrounded on all sides in the same plane by the granular bodies mentioned above.

There are three distinct tubular organs in the interior of this proglottis, to which I give the following interpretation: First, the vagina, a comparatively large duct which appears to have its exterior opening at the margin, coincident with or immediately behind the opening of

the cirrus. From this point it can be traced towards the median line after having made a slight bend forward at the base of the cirrus bulb. It then leads to the ovaries, at the anterior end of which it enlarges abruptly and is joined to a much smaller tube, which continues in a very sinuous course to the base of the cleft between the two lobes of the ovary. A second small and very much folded tube, evidently the vas deferens, enters the inner end of the cirrus bulb at its anterior angle. From that point it can be traced forward a short distance, then back along the median line, where it lies in dense folds or plaits, nearly to the anterior edge of the ovary, where its course becomes somewhat doubtful. A third large, straight tube with thick granular walls lies along the median line from about the anterior third to a point a little in front of the ovaries; there it becomes abruptly enlarged, rounded, or pyriform and is joined by a small duct. This duct is much folded or plaited, lies between the lobes of the ovary, but extends a little way in front of the ovaries to enter the pyriform termination of the straight median duct. In some segments a round, lateral aperture was observed at a point which corresponds to the anterior termination of the median duct. In segments with ripe ova the region along the median line becomes distended with ova, which may be seen, in some at least, issuing from the lateral aperture. The ova, in some of the sections stained with carmine, are of a light amber color, oval, much collapsed, about .05^{mm} in length and .02^{mm} in breadth. In other sections there were a few ova which were apparently not yet provided with shells. They were shorter oval than the mature ova, about .035^{mm} and .024^{mm} in their two diameters, and their granular contents deeply stained. The central mass of ova in mature segments appears as a dark colored spot in alcoholic specimens, sometimes likewise in living specimens.

In stained sections the ovary was seen to be composed of polygonal, nucleated cells, about .008^{mm} in diameter. The nuclei were about .002^{mm} in diameter. Flat nucleated cells, somewhat smaller than the cells of the ovary were found in the walls of the convoluted tube which lies between the two lobes of the ovary. In sections of some of the segments the nests of nuclei, which constitute the testes, were seen to be breaking up into fine fibrillæ, presumably spermatozoa. This phenomenon was best seen in segments which had but few or no ova. In sections of segments which contained many ova there were large spaces from which the nuclear aggregations of the testes had disappeared, leaving a net-work of connective tissue. In the strands of this net-work there are occasional minute fusiform nucleated cells.

The walls of the mature segments, even those which are crowded with ova, are plentifully supplied with both longitudinal and transverse muscular fibers. These are pretty evenly distributed. The fact that the muscular tissues do not soon degenerate is also shown by the long continued vitality of the free proglottides. They continue active after lying in sea water for several hours. It is probable that they continue to grow for some time after becoming free from the strobile.

The sketch made from a living proglottis, Fig. 8, Plate X, shows the character of the cirrus bulb, the vagina, and some of the convolutions of the vas deferens. The vagina expands to form a large receptaculum seminis. This feature was indicated in sections of preserved specimens by the relaxed and folded walls of the vagina. In the figure the ovaries are obscured by the large, globular, spermatic capsules of the testes. The cirrus bulb is oblong, its inner end directed forward. It frequently protrudes in a broad, expanded collar a short distance beyond the margin of the segment. The cirrus is smooth. It is shown in Fig. 9 with spermatozoa issuing from its extremity. The spermatozoa are ejected in large quantities and appear to be felted together in elongated masses without any fluid medium.

28. *Rhynchobothrium tumidulum*, sp. nov.

[Plate xi, Figs. 3–11.]

Head with two round-oval or elliptical bothria, which are marginal or, by torsion, lateral, approximate anteriorly, widely separated posteriorly, emarginate on posterior border in life, almost entire in alcoholic specimens, very mobile. Neck variable in length according to state of contraction, but comparatively long—that is, three to five times the length of the head; in life subcylindrical, very elastic, capable of being much elongated or greatly shortened, and with a crimson spot in front of contractile bulbs. Proboscides long, slender, longer than the bothria, slightly enlarged at base; armed with minute hooklets of two kinds, one short, sharply and abruptly recurved with a broad base, the other slender, a little longer than the first kind, arcuate. Hooklets on tumid base short, and crowded in close spirals. Proboscis sheaths spiral, contractile bulbs long, slender, arcuate, sometimes decussate. Body continuous with neck, the first segments faintly outlined by transverse striæ. The first distinct segments appear at a short distance behind the contractile bulbs and are much broader than long; succeeding segments squarish, sometimes with rounded corners, soon becoming longer than broad; posterior segments several, five or more times as long as broad, often fusiform, sometimes with deep emargination at posterior end, separating easily from strobile. Whole number of segments twelve, more or less. Male genital aperture marginal, near posterior third. Length, 5 to 12^{mm}.

Habitat.—Mustelus canis, spiral valve, frequent, Wood's Holl, Massachusetts, July and August.

I have obtained this species from the spiral valve of the smooth dogfish (*Mustelus canis*) on several different occasions, but never in great numbers. It is usually associated with *R. bulbifer*, *Calliobothrium verticillatum*, and *C. eschrichtii*.

Following is a list of the captures of this worm:

Date of capture.	No. of dog-fish examined.	No. of specimens of *R. tumidulum* obtained.
1886.		
July 23	Three	Twelve.
24	Four	Five.
31	One	Two.
1887.		
19	Six	Eighteen.
21	Ten	Eight.
23	One	Two.
Aug. 4	Three	One.
10	Three	One.
11	Two	Fifteen.

Accurate measurements of the living worm are very difficult to obtain on account of the extreme variability of form due to the excessive contractility. The longest specimens measure from 10 to 12^{mm} and consist of from twelve to fourteen distinct segments. In one specimen, which measured 10^{mm} in length and had twelve segments, the last segment varied in length from 1.5 to 4^{mm}, with different degrees of contraction. The head and neck in this specimen were much contracted, and measured 1^{mm} in length. Of the twelve segments, the first four or five were very short and crowded together, the next squarish, the following ones longer than broad, the last three capable of considerable elongation. The posterior end of the last segment was deeply and abruptly emarginate. The bothria appeared to be marginal.

The following measurements are of living specimens:

Dimensions.	No. 1.	No. 2.	No. 3.
	mm	*mm*	*mm*
Length	5.20	5.40	11.60
Length of bothrium	0.26	0.30	.....
Breadth of bothrium	.....	0.30	.....
Breadth of head	0.54	.....	.....
Length of head and neck	0.80	1.00	.....
Diameter of neck	.....	0.44	.....
Length of last segment	1.46	1.30	3.20
Breadth of last segment	0.44	0.46	0.80

For No. 3 of the above table the following additional measurements are given: Length of last segment but one, 2.80^{mm}; breadth, 0.72^{mm}; distance from base of contractile bulbs to first distinct segment, 0.20^{mm}; length of first distinct segment, 0.08^{mm}; breadth, 0.36^{mm}; number of segments, 14; length of crimson spot in the contractile neck, 0.44^{mm}; length of contractile bulbs, 0.40^{mm}. The crimson spot in front of the contractile bulbs is due to the coloration of granules in the parenchyma of the neck. It is quickly dissolved by alcohol.

The bothria are very mobile in life, being sometimes turned forward so as to present two cupping dishes directly in front; at other times both are turned over so as to be applied to the same surface, when they act as suctorial discs to aid the worm in locomotion. The edges of the bothria are somewhat thickened, the face hollowed out and the posterior margins emarginate. This latter feature is retained in but few of the alcoholic specimens, and in them usually with not much distinctness.

On two different occasions I have observed what I am disposed to interpret as embryos which have escaped from the ova before leaving the mature segments. They presented exactly the same character on each occasion. They are long ovate, or rather conical, broadly rounded at one end, tapering to a point at the other, with a few clusters of curved bristle-like spines at the smaller end, and near the larger end. They were first noticed in the summer of 1886, when they were seen, along with undoubted ova, issuing from living segments in sea-water. They measured .055^{mm} in length and .023^{mm} in diameter near larger end, while the length of the bristles was about .012^{mm}. The ova were about the same length as these bristle-bearing embryos and twice as broad. In July, 1887, while examining some specimens of this rhynchobothrium which had been placed in sea water under a compressor, I observed multitudes of these highly characteristic objects. They were .048^{mm} in length and .016^{mm} in breadth at larger end. It was observed that segments of this worm, after lying for a few minutes in sea water, burst at irregular places, allowing the escape of these embryos. Along with these conical bodies were great numbers of small globular masses .0076^{mm} in diameter. The latter were highly refractile and contained two or three, sometimes more, nuclear granules. They probably come from a layer of roundish granular bodies which lie beneath the muscular walls of the segment. In a few instances the wall of a segment was observed to swell out into one or more bud-like prominences from which the embryos and the small refractile bodies presently burst forth. The embryos, after having been discharged for about an hour in sea water, changed from a transparent or translucent white to a very dark brown or black. My attention was first called to this fact by noticing patches of some black substance in the bottom of a dish of sea water in which a number of these worms had been placed. Upon examination these patches proved to be made up of these characteristic embryos, but most of them quite black. A few were unchanged, or but little changed. In the dark-colored ones the bristle-like spines are much more distinct than in the colorless ones. This is doubtless due to the change of color which affects the bristles as well as the rest of the object, making them opaque. These spines are now seen to be strongly curved, to occur at the smaller end and also in a ring of irregular bunches near the larger end. No movements were observed in any of

these objects. An examination of the alcoholic specimens has resulted in finding several of these embryos clinging by their spines to the proboscides and other parts.

Thin longitudinal sections were made of a mature segment, the anterior half and more of whose interior was dark colored from the presence of ova. The sections show that the anterior part of the segment is a veritable egg-sac. Instead of ova with definite outlines, however, it seems to contain nothing but a mass of collapsed egg-shells or cases of a yellowish-brown color. In two or three cases I was able to make out irregular conical outlines which agree in shape and size to the free embryos. I saw nothing which I could certainly identify as embryos.

Anatomy of mature segments.—My investigations on the anatomy of the posterior segments have as yet been rather unsatisfactory. The cirrus, which was not seen everted, appears to be short and smooth, and in one instance was about .03^{mm} in diameter. The cirrus bulb is oval and lies nearly at right angles to the axis of the segment. In segments which do not contain ova the ovaries can be seen at the posterior end as comparatively small paired organs, while the remainder of the interior of the segment, except so much as is occupied by the cirrus bulb, is filled with oblong testicular bodies, which lie close together, at right angles to the axis of the segment and in two longitudinal rows, one on each side of the median line. These are separated from the marginal walls by a row of smaller, roundish granular masses. In the stained sections which I have thus far prepared there are but few traces of tubular organs or ducts. A rather large convoluted mass lies in front of the ovaries which may represent the vas deferens. A tubular vessel, somewhat folded or sinuous, could be seen leading from the vicinity of the ovary forwards along the median line. I infer from the disposition of such parts as I can make out that the vagina opens marginally beside the cirrus. In front of the cirrus a space along the median line becomes modified into a capacious uterus with, at first, sacculated walls, but which ultimately comes to occupy all the anterior two-thirds of the segment.

The following dimensions of proboscides and hooks may be of assistance in future identifications:

	Base.	Middle.
	mm.	*mm.*
Diameter of proboscis, exclusive of hooks	0.022	0.019
Length of hooks	0.006	0.008
Distance between spirals	0.008	0.014
Number of hooks visible in one spiral	12	12

This species seems to be near *R. rubromaculatum* Dies. (*Tetrarhynchus Trygonis pastinaceæ* Wagener.)

29. *Rhynchobothrium hispidum*, sp. nov.

[Plate xi, Figs. 12–17.]

Bothria two, lateral, entire, subelliptical, edges elevated, face hollowed out to form a cupping-disk, widely separated posteriorly, somewhat approximate anteriorly. Neck relatively long, wider than first segments, subcylindrical, very contractile, with two small crimson spots immediately in front of the contractile bulbs; when highly magnified seen to be densely covered with minute short bristles. Proboscides very long, slender, armed with hooks of two principal sorts, one sort short, sharply recurved and very broad at the base, the other sort slender and arcuate, but stouter than those of *R. tenuispine*, and not so close together. First two segments short, squarish, indistinct, broader than long, third segment about as long as the first two, fourth segment about as long as the second and third, remaining segment increasing in length, last segment very much longer than broad. Whole number of segments about six. Posterior segments separating easily, usually very long and slender and somewhat fusiform. Genital apertures, male marginal, about posterior third. Length from 4 to 8^{mm}.

Habitat—Trygon centrura, spiral valve, July and August. Wood's Holl, Massachusetts.

At different times during the past two summers I have found some exceedingly small *Rhynchobothria* in the spiral valve of the sting-ray (*Trygon centrura*), the most of which were characterized by having two small red spots in the substance of the neck in front of the contractile bulbs. It has so happened that I have obtained several other more conspicuous forms at the same time, so that these smaller forms have never been studied carefully while living. Upon examining the alcoholic specimens I find it necessary to separate these small *Rhynchobothria* into three distinct species on account of the profound difference in the style of hooks. These species bear a close resemblance to Van Beneden's *Tetrarhynchus minutus* from *Squatina angelus*, but differ from it in having the crimson spots in the neck. Van Beneden, furthermore, represents his species as having the bothria profoundly bilobed and the hooks, according to his figure, of uniform size. The species *R. tenuispine* resembles *R. heteromerum* Dies. in some particulars. The resemblances and differences are mentioned under the description of *R. tenuispine*.

R. longispine may prove to be a variety of *R. hispidum*.

I have found *R. hispidum* on three different occasions as follows:

Date of capture.	No. of rays examined.	No. of worms found.
July 29, 1886	One	Twelve.
Aug. 1, 1887	Three	Many.
Aug. 10, 1887	Two	Two small.

It was found almost impossible to make satisfactory measurements of living worms on account of their great activity and consequent extreme variability. In the following measurements of living specimens the dimensions of the head, neck, and length of strobile are approximate:

Dimensions.	No. 1.	No. 2.
	mm.	*mm.*
Length	4.50	7.80
Length of bothria	0.20	0.16
Breadth of head	0.45	0.34
Length of neck	1.00	0.80
Breadth of neck	0.16	0.20
Length of contractile bulbs	0.60	0.46
Breadth of contractile bulbs	.....	0.04
Length of first segment	0.08	0.06
Breadth of first segment	0.16	.....
Length of last segment	1.10	3.60
Breadth of last segment	0.16	0.46
Number of segments	5	6

The following additional measurements of No. 2 are given to show the proportions of the segments: Length of first segment, .06^{mm}; second, .10^{mm}; third, .26^{mm}; fourth, .70^{mm}; fifth, 2.10^{mm}; sixth, 3.60^{mm}.

The following measurements are of alcoholic specimens:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length	4.00	4.20	4.40	4.00
Breadth of head	0.30	0.24	0.28	0.26
Length of head and neck	1.20	1.10	1.30	1.20
Breadth of neck	0.20	0.20	0.20	0.24
Length of contractile bulbs	0.56	0.56	0.64	0.50
Length of first segment	0.06	0.04	0.06	0.05
Breadth of first segment	0.17	0.15	0.12	0.16
Length of third segment	0.16	0.12	0.14	0.14
Breadth of third segment	0.14	0.14	0.11	0.14
Length of fourth segment	0.36	0.30	0.34	0.32
Length of last segment	1.40	2.10	1.60	1.40
Breadth of last segment	0.20	0.16	0.14	0.22
Number of segments	6	6	6	6

The first segment is here reckoned from the base of the contractile bulbs to the first transverse line. The second segment has about the same dimensions as the first. In specimens that are in glycerine the segments are somewhat opaque, while the neck and head are quite transparent.

Only one of the alcoholic specimens had more than six segments. It had about eight distinct segments, which were more rounded, bead-like, and shorter in proportion to the length than in the others. The last segment is not so long in proportion to the others. The proboscides were retracted and the hooks could not be seen plainly, but the specimen is apparently the same species as the others.

One free segment, alcoholic, measured 2.6mm in length, 0.22mm in breadth at anterior end, 0.16mm at posterior end, and 0.32mm at posterior third at the genital aperture.

Many of the alcoholic specimens have the proboscides everted as much as .7mm, or more than three times the length of the bothria. Their diameter is about .02mm, exclusive of hooks; greatest diameter observed from tip to tip of hooks, .04mm.

The character and arrangement of the hooks is shown in the sketches. There is a single longitudinal row of short hooks with very broad bases. On each side of this row there is a series of about four rows of long slender hooks, and on the opposite side of the proboscis a series of about five small slender hooks. There is considerable variety in shape and size of the slender hooks. The broad hooks are recurved at the point and widen rapidly towards the base, at which there is a prominent posterior prolongation, which makes the length of the base exceed the length from base to apex. One of the broad hooks measured .011mm in length, while the breadth of the base was .016mm; another .008mm in length was .011mm broad at base. The hooks are larger at the base of the proboscis than they are at the apex. The slender hooks present rather more variety in size, if not also in shape, than the broad hooks. In general they are somewhat longer than the broad hooks, slender, tapering uniformly to the point and slightly recurved or arcuate. They also become smaller towards the apex of the proboscis. One of the largest measured .013mm in length and .004mm in breadth at base.

The ova, which were seen issuing from the posterior segment of a living specimen under the compressor, measured .025mm in diameter. They consist of a thin, fragile hyaline shell surrounding a clear space in which is a granular nucleus.

The last segment in the largest specimen contained mature ova. The last but one is characterized by having the greater part of the interior filled with rather large, oblong, or squarish masses, which lie in two longitudinal rows on either side of the median line. The median and anterior parts of the segment are filled with ova.

The male genital aperture is marginal and near the posterior third. The segment usually has its greatest diameter in the vicinity of the genital aperture. In one segment a smooth, slender cirrus was extruded from the center of a wide marginal sinus. I have not yet succeeded in demonstrating the position of the vaginal aperture. The posterior segments in alcoholic specimens are often arcuate.

30. *Rhynchobothrium longispine*, sp. nov.

[Plate XI, Figs. 18–20.]

Head short and broad. Bothria two, marginal (?), suborbicular, widely separated; neck rather long, broader than first segments; proboscides long, slender, and armed with relatively large, prominent hooks;

sheaths spiral; contractile bulbs long, slender, and parallel. First segments rectangular, broader than long; subsequent segments increasing in length rapidly; posterior end of last segment emarginate.

Genital aperture of male marginal, about posterior third. Species near *R. hispidum*, but with relative longer and larger hooks on proboscides.

Habitat.—*Trygon centrura*, spiral valve, July, 1886; August, 1887; Wood's Holl, Massachusetts.

In two lots of small *Rhynchobothria* which were distinguished at the time of collecting by their small size and the occurrence, at least in a majority of them, of two red spots in the neck, in front of the contractile bulbs, and which were found to be made up for the most part of the two species *R. hispidum* and *R. tenuispine*, there were two very small individuals which I am obliged to refer to a distinct species. These specimens have lost the posterior segments. The description given rests mainly on the characters of the bothria, proboscides, neck, and first segments. It is probable that there are red pigment spots in the neck as in the two associated species, but this can not be affirmed certainly, since the specimens were not separated from *R. hispidum* until after they had been for some time in alcohol.

The short and broad character of the head may not be true for the living specimens, since the bothria are doubtless mobile. It is to be observed, however, that the shape of the heads of these two specimens is unique when compared with the alcoholic specimens of *R. hispidum*, although individuals of that species were observed to assume positions while living that were much like that which characterizes *R. longispine*.

In the larger specimen of the two the first two segments are rectangular, broader than long, the third is nearly square, the fourth is considerably longer than broad, while the fifth and last is as long as all the preceding segments taken together; its posterior end is emarginate. The smaller specimen differs from the larger only in having three instead of five segments.

The principal difference between this species and *R. hispidum* is in the hooks. These, at least near the base, appear to have the following arrangement: There is first a longitudinal row of broad, stout, abruptly recurved hooks; second, the row of broad hooks is flanked on either side by a series of long, slender, arcuate hooks arranged side by side in groups of four. Between the two latter series, on the side of the proboscis there is a longitudinal space from which hooks are apparently absent. All the hooks are prominent and stand out at nearly right angles to the axis of the proboscis. The following measurements show some of the differences between this species and *R. hispidum*: Diameter of proboscis exclusive of hooks 0.02^{mm}, including hooks 0.05^{mm}; length of broad hooks at base of proboscis 0.019^{mm}, breadth 0.019^{mm}; length of broad hooks middle of proboscis 0.008^{mm}, breadth 0.009^{mm}; length of slender hooks 0.02^{mm}, breadth 0.006; distance between transverse spirals 0.02^{mm}.

Following are the dimensions of the two alcoholic specimens:

Dimensions.	No. 1.	No. 2.
	mm.	*mm.*
Length	2.30	1.26
Length of head	0.16	0.20
Breadth of head	0.36	0.42
Length of head and neck	0.86	1.00
Breadth of neck	0.16	0.22
Length of contractile bulbs	0.46	0.48
Length of first segment	0.04	0.06
Breadth of first segment	0.14	0.14
Length of last segment	1.04	0.20
Number of segments	5	3

The first two segments are rather indistinct and indicated by two transverse lines. The last segment in No. 1 is linear, rectangular, and about the same breadth as the first segment. There is an ovary at the posterior end and a series of comparatively large, subelliptical bodies, presumably the testes filling up the interior. There is also a faint indication of the beginning of a cirrus bulb just back of the posterior third and near the margin.

I would prefer to regard this species as a variety of *R. hispidum* if it were not for the difference in the character of the hooks.

31. *Rhynchobothrium tenuispine*, sp. nov.

[Plate XII, Figs. 1, 2.]

Head and neck much as in *R. hispidum*, but red spots in neck indistinct or absent altogether. Proboscides long and slender, densely beset with exceedingly minute spinose hooks, slightly swollen near the base. A few of the hooks behind the tumid part are strongly recurved and a little stouter than the others. On the tumid part and as far forward as could be seen the hooks are slender, spinose, and slightly recurved. On one side of the tumid base there are a few slender hooks with abruptly recurved points. First two segments usually moniliform; remainder of strobile much as in *R. hispidum*.

Habitat.—*Trygon centrura*, spiral valve, August 1 and 3, 1887, Wood's Holl, Massachusetts.

In the following measurements from alcoholic specimens the diameter of the head is the maximum, obtained by measuring the head in lateral view, in which the bothria appear as widely flaring at the posterior edges. Only the measurements of head, neck, and first segments are given. In all the alcoholic specimens the posterior segments have dropped off.

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length of head and neck	1.10	1.00	1.00	1.30
Breadth of head	0.20	0.22	.....	0.32
Breadth of neck	0.14	0.10	0.10	0.14
Breadth of neck at contractile bulbs	0.20	0.16	0.16	0.26
Length of contractile bulbs	0.50	0.40	0.40	0.60
Length of first segment	0.10	0.12	0.12	0.12
Breadth of first segment	0.10	0.08	0.12	0.20

In all the above, except No. 4, the first two segments were rounded at the extremities so as to appear distinctly beaded.

A few mature segments associated with this lot measured as much as 1.6^{mm} in length and 0.3^{mm} in breadth. They are elongated, oppressed at the ends, tapering gently towards the posterior end, with somewhat irregular sinuous outline.

The proboscides are evidently very long, since, although none were seen fully everted, they could in some instances be traced back, not only through the entire length of the sheaths, but into the contractile bulbs themselves.

The following measurements of proboscides and hooks are from alcoholic specimens:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Diameter of tumid base of proboscis	0.027	0.022	0.025	0.019
Length of hooks in front of tumid base	0.003	.....	0.003	0.005
Maximum length of hooks near base	0.006	.....	0.006	0.007
Breadth of largest hooks	.....	.....	0.001	0.001
Diameter of proboscis in front of tumid base	0.020	0.016	0.017	0.014

In all cases, with one exception, these specimens with the fine hooks on the proboscides had moniliform anterior segments, usually two in number. Conversely the coarser hooked proboscides of *R. hispidum* were associated with indistinct, squarish, anterior segments.

This species is evidently near *R. heteromerum* Diesing, with which it agrees closely, with the exception of that very important character, the length of the proboscides. According to Diesing's description, the proboscides are scarcely longer than the bothria. Diesing's species is made to accommodate Wagener's *Tetrarhynchus trygonis brucconis*. Wagener's figure of this species represents a worm with short proboscides, or, what is more likely, with long proboscides partly everted. In the absence of a better description of the hooks on the proboscides than is given for *R. heteromerum*, it is not possible to refer any of these small *Rhynchobothria* from *Trygon centrura* to that species.

32. *Rhynchobothrium heterospine*, sp. nov.

[Plate XII, Figs. 3–6.]

On August 4, 1886, I obtained a single immature *Rhynchobothrium* from the spiral valve of the smooth dog-fish (*Mustelus canis*), which, upon re-examining at leisure, I find is specifically different from the other *Rhynchobothria* in my collection. I either neglected to make notes of this specimen while it was living or, if notes were made, they have not since turned up. The specimen has been subjected to some pressure while in a fresh state, and its flattened condition makes it difficult to determine whether the bothria are marginal or lateral, and, of course, exaggerates the measurements of breadth.

Bothria two, opposite, lateral, short-elliptical or suborbicular. Neck long, cylindrical, compressed, slightly enlarged at base, in vicinity of contractile bulbs. Proboscides very long and slender, sheaths spiral, contractile bulbs linear-oblong. Hooks mostly slender, but of very diverse shapes.

Segments begin some distance back of contractile bulbs. Last segments elongate. Genital apertures marginal.

Habitat.—*Mustelus canis*, spiral valve, single immature specimen, August 4, 1886, Wood's Holl, Massachusetts.

The dimensions of the alcoholic specimen, much flattened, are as follows: Length, 13.50^{mm}; length of head, 0.60^{mm}; breadth, 0.70^{mm}; diameter of neck, 0.26^{mm}; length of head and neck, 3.00^{mm}; length of proboscides, approximate, 1.60^{mm}; length of contractile bulbs, 0.52^{mm}; breadth, 0.12^{mm}.

In this specimen, which is evidently immature, the segments are indistinct. The last segment measures 1.80^{mm} in length and 0.50^{mm} in breadth and tapers to a blunt point at the posterior end. Three or four elongated segments are marked off at the posterior end of the strobile by faint transverse lines. These are filled by the characteristic nuclear masses which precede the genitalia in the *Cestoda*, and from which the organs of the segment are differentiated. The genital organs are not yet distinct but are sufficiently developed to show that the male genital aperture is marginal.

The diameter of the proboscides, exclusive of hooks, is about 0.03^{mm}; with hooks included it is about 0.05^{mm}. The maximum length of hooks is 0.027^{mm}, their breadth 0.005^{mm}. In general the hooks are of at least four kinds, which, graduating as they do into each other, produce some very diverse forms. First, there are nearly straight hooks tapering to a sharp point; second, slender, arcuate, sharp-pointed hooks; third, slender, straightish hooks with abruptly recurved point, some transition forms with gentle sigmoid curve like the leter S partly straightened out; fourth, like the third form, into which it graduates, except that the shaft of the hook is quite broad in a plane coinciding with the longitudinal axis of the proboscis, the recurved end separated from the shaft by a

narrow notch. Since these varieties graduate into each other, it can be readily understood that there must be much diversity in the shape of the hooks of this species. Some of the straight, slender hooks, when seen as they lie on the side of the proboscis which is directly in view, are quite broad toward the base, being flattened in a plane which is at right angles to the longitudinal axis of the proboscis. These hooks when seen in this position with their broad basal supports look like broad, thin tacks. Eight or nine hooks can be seen at once in a single transverse spiral. The longest hooks that were measured were near the base of the proboscis. The hooks vary in length from 0.013 to 0.027^{mm}. The average length is perhaps not far from 0.016^{mm}.

33. *Rhynchobothrium imparispine*, sp. nov.

[Plate XII, Figs. 7–9.]

Bothria two, lateral, oblong-elliptical, distinctly emarginate posteriorly, deeply hollowed out on the face, margins slightly inverted, very versatile, head quite broad, bluntly sagittate, the bothria flaring outward at their posterior edges, approaching each other but not touching anteriorly. Neck three or four times as long as the head, cylindrical in front, flattened posteriorly. Proboscides long, moderately slender, armed with hooks which present great differences both in shape and size; sheaths spiral; contractile bulbs long, slender, tapering slightly posteriorly. First segments begin a short distance behind the neck, exceedingly short, subsequently increasing in length uniformly, becoming at length elliptical-oblong and longitudinally striated. Ultimate and free segments much longer than broad, with about fourteen longitudinal muscular striæ on a lateral side.

Genital apertures; male, marginal near posterior end, from deep rectangular marginal notch. Length 50^{mm}.

Habitat.—*Raia erinacea*, spiral valve, one specimen, Wood's Holl, Massachusetts, August 29, 1887.

On August 29, 1887, I examined twenty-four specimens of the Summer-skate (*Raia erinacea*). Their stomachs were filled with small crustacea, mostly shrimps (*Crangon vulgaris*), and annelids of the genera *Nereis* and *Rhynchobolus*. The entozoa from this lot of skates were several specimens of *Echeneibothrium variabile* from the spiral valve of some, a number of Nematods from the stomach and spiral valve of some, and a single *Rhynchobothrium*, the subject of this sketch.

The living specimen was very active when placed in sea-water and changed its form so incessantly that it was impossible to obtain satisfactory measurements. The bothria were plainly two, although appearing bilobed, on account of the deep posterior emargination. They were very versatile and were frequently directed forward, assuming then a cupular shape. The last segments were plump, the whole worm being in fact rather thick. The length was 50^{mm}; breadth of head, 1^{mm};

breadth of neck, 0.6mm; length of neck, 4.5mm; length of last segment, 2.5mm; breadth, 1.65mm. A free segment, which I think belonged to this specimen, measured 5mm in length. When placed in sea-water it discharged a mass of eggs which spread out on the bottom of the dish making a spot 5mm in diameter which was at first an opaque white color changing after a few hours to dark brown.

The following data were obtained from the alcoholic specimen: The bothria are 1mm in length and 0.76mm in breadth. In lateral view, marginal as to the body, the head is 1.26mm broad in posterior diameter, 0.6mm in anterior diameter. The neck in front of the contractile bulbs is cylindrical and about 0.6mm in diameter immediately behind the bothria, increasing to 0.8mm immediately in front of bulbs. In the vicinity of the bulbs the neck flattens to coincide with the flattened body. At the base of the contractile bulbs the marginal diameter is 0.47mm, lateral 0.66mm. Length of contractile bulbs 1.66mm, breadth 0.28mm. Approximate length of proboscides 2mm; diameter, exclusive of hooks, 0.1mm, diameter including hooks from 0.14 to 0.16mm. In general there are two sorts of hooks classified according to size. The largest hooks have linear dimensions which are ten or even twenty times those of the smallest hooks. There are, however, a few that are intermediate between the larger and smaller hooks. Of the larger hooks there are three principal types. In the first type the hooks have broad bases abruptly and strongly recurved, the recurved part parallel with the axis of the proboscis or even turned a little toward the proboscis and equal in length to half the entire length. These hooks are the largest and strongest of all. At the base of the proboscis they measure 0.06mm from tip to opposite extremity of basal support, length of base 0.04mm, breadth of hook near middle 0.02mm. Toward the end of the proboscis these hooks grow smaller, the corresponding dimensions of a similar hook there being 0.03mm, 0.02mm, 0.01mm. There appears to be a single longitudinal row of these stout hooks, with two additional rows of hooks of nearly similar shape but smaller in size. The second type of large hooks is long, more slender than the foregoing, and strongly but not so abruptly recurved, with rather blunt points. One row stands near the row of stout hooks. At the base of the proboscis they measure, with the curve, as much as 0.06mm in length and are about 0.01mm broad at base. Towards the apex of the proboscis they become shorter and more slender. The tip of the recurved part was in some cases observed to bend toward the proboscis to form a veritable hook. The third style of large hook is slender, arcuate, rather sharp pointed, 0.04mm in length and 0.013mm broad at base, tapering uniformly to the tip. There are also some similarly shaped hooks about one-half as long and about one-third as broad. Closely allied to this style are some slender hooks which are curved in two planes, like the horns of an ox. Next below these come the largest of the small hooks, not more than 0.014mm in length. The smallest hooks are only about 0.002mm in length. On one side of the proboscis these

small hooks are arranged in double transverse rows between the transverse rows of large hooks. In this case the hooks in the anterior row are much longer than those in the posterior row, while in both the hooks are slender. On the side of the proboscis opposite the row of broad, stout hooks there is, at least at the base of the proboscis, a longitudinal space in which there are no large hooks. This space is densely covered with small hooks, which are very short, with broad bases. There appear to be about nine longitudinal rows of large hooks, the hooks in each row differing more or less from those in every other. The figures (Figs. 8 and 9, Plate XII),—while not showing all the varieties of hooks, nor their arrangement in toto, give a very correct idea of the kind of hooks and their arrangement.

Transverse striæ, indicating the beginning of segments, begin about 0.4^{mm} back of the contractile bulbs. The first distinct segments are 0.6^{mm} wide and 0.06^{mm} long. One of the posterior segments had the following dimensions: Length, 2.4^{mm}; breadth, anterior 1.2^{mm}, at marginal aperture 1.48^{mm}, posterior 1^{mm}; thickness, 0.9^{mm}; marginal genital aperture about 0.7^{mm} from the posterior end. When the cirrus is retracted it leaves a rectangular notch or emargination, with rounded, projecting lips. The cirrus was partly everted in one segment; it scarcely extended beyond the marginal notch, which it filled completely. It measured 0.12^{mm} in length and 0.1^{mm} in diameter, was smooth, tumid at outer end and at base, with constriction in the middle.

When placed in glycerine the posterior segments are seen to be marked with a number—fourteen, more or less—of longitudinal striæ, which converge at the two extremities near the median line, whence they radiate like meridian lines from the poles of a globe.

Anatomy of posterior segments.—An examination of a few thin sections of posterior segments yields the following rather meager data: The ovaries lie near the base of the segment and consist of two paired, roundish organs, lying on either side of the median line, each about 0.2^{mm} in diameter, and made up of small, polygonal, nucleated cells 0.005^{mm} in diameter. A convoluted mass of one or more tubes lies immediately in front of the ovaries, occupying the median line from the anterior edge of the ovaries to a point a little in front of the cirrus bulb, thence it bends back and communicates with the cirrus bulb. It is evidently, in part at least, the vas deferens. In front of this convoluted mass there is a thick-walled tube of very different appearance, which extends along the median line and appears to approach the exterior at the anterior edge of the segment. This is probably the uterus, and its extremity at the anterior edge of the segment an external orifice whence ova are expelled from ripe proglottides. I can find no trace of a vagina, unless the thick-walled tube which I suppose to be the uterus should prove to represent that organ. A very characteristic feature of these segments is the strong bands of longitudinal striæ which lie in the lateral walls. Ova were observed in some of the sections. They lay in the postero-

median part of the segment and were much collapsed. They measured about 0.05^{mm} and 0.025^{mm} in their two diameters.

On September 6, 1887, I obtained a large, free proglottis from this same species of skate (*Raia erinacea*) which belongs undoubtedly to this *Rhynchobothrium*, although no *Rhynchobothrium* scolex was found. The proglottis was 1^{mm} broad and 3.5^{mm} long. Ova were observed making their escape from the compressed segment in glycerine at the genital aperture near one of the margins. They are collapsed and measure 0.055 and 0.027^{mm} in their two diameters. Longitudinal striæ appear which converge at the two ends to a small circular hilum, which marks the former point of attachment to adjoining segments.

This species is evidently near Van Beneden's *Tetrarhynchus erinaceus* from *Raia rubus*, which it closely resembles in the character of its hooks. It also possesses many characters common to *Rhynchobothrium commutatum* Dies., and *R. ambiguum* Dies.

34. *Rhynchobothrium wageneri*, sp. nov.

[Plate XII, Figs. 10–12.]

Bothria two, lateral, orbicular, or, in alcoholic specimens, broadly elliptical, emarginate on posterior edge, somewhat bilocular, converging in front, widely divergent behind, with smooth, thickened, and elevated edges. Proboscides four, in two pairs, a pair issuing from anterior part of each bothrium. Inner side of base of each proboscis with a prominent shoulder, and with a single large, recurved hook on outer side opposite the shoulder; base of proboscis covered with small, slender hooks, remainder of proboscis armed with larger hooks. Proboscides three or four times as long as bothria, tapering gradually to apex. Neck long, cylindrical, broader than the body, very contractile in front of bulbs; proboscis sheaths in loose spirals; contractile bulbs very long, parallel. Body crossed by a narrow, transverse, crimson band immediately behind the contractile bulbs. The segments begin almost immediately behind the contractile bulbs. The first three or four distinct segments are broader than long. The next are squarish. At about the tenth they begin to elongate and mature. They increase rapidly in length towards the posterior end, the median ones becoming bacilliform while the last one is, in some cases, eight or ten times as long as broad. The last two or three are usually very long, fusiform, of an ivory-white color, and discharge ova when placed in water. The body throughout is almost cylindrical. Genital apertures marginal near middle of segment. Ova spheroidal, 0.029^{mm} in diameter. Length, 18^{mm}.

Habitat.—*Trygon centrura*, spiral valve, about ninety specimens from two rays, Wood's Holl, Massachusetts, August 10, 1887.

Of the following measurements, those of No. 1 are of a living specimen, Nos. 2 and 3 are of alcoholic specimens.

Dimensions.	No. 1.	No. 2.	No. 3.
	mm.	*mm.*	*mm.*
Length	18.00	13.00	14.00
Breadth of head	0.80	0.54	0.52
Length of head	0.46	0.28	0.24
Length of head and neck	3.00	2.20	2.40
Diameter of neck	0.64	0.32	0.30
Length of contractile bulbs	2.00	1.20	1.26
Breadth of contractile bulbs	0.20	0.10	0.10
Length of first segment, approximate	0.03	0.03	0.03
Breadth of first segment	0.30	0.24	0.22
Length of last segment	4.00	2.40	2.80
Breadth of last segment	0.46	0.50	0.44
Length of proboscis	1.60	1.40	1.20
Diameter of proboscis at base	0.08	0.08	0.08
Diameter of proboscis near apex	0.04	0.05	0.05
Number of segments	20	16	16

In the alcoholic specimens the length of bothrium was 0.28^{mm}, breadth 0.30^{mm}. The anterior segments were indistinct.

The base of each proboscis for a distance of about 0.12^{mm} is 0.08^{mm} in diameter. At this point there is a sudden offset where the diameter suddenly diminishes to 0.06^{mm}, thus giving rise to a prominent shoulder which is always on the inner side of the proboscis. The basal part of the proboscis is thickly covered with slender, slightly recurved hooks, which are from 0.005 to 0.010^{mm} in length and less than 0.002^{mm} in thickness. These hooks are arranged in spirals, the coils of which make rows of hooks almost transverse to the axis of the proboscis. The hooks are longer and straighter near the head than they are at the offset. On the outer side of the proboscis, opposite to and a little way back of the basal shoulder, there is a single large hook. This hook is broad, recurved and has a strong basal support. Its length is 0.04^{mm}, breadth at surface of proboscis 0.017^{mm}, breadth of basal support 0.021^{mm}. Beyond the basal shoulder the proboscis tapers very gradually to the apex, which in well everted proboscides is about 0.04^{mm} in diameter, or one-half the diameter at base. The proboscis in front of the basal shoulder is covered with slender hooks, which are for the most part but slightly recurved. The maximum length of these hooks is about 0.015^{mm}, breadth at base 0.002^{mm}. They are arranged in spirals 0.016^{mm} apart, eight or nine hooks being visible in a single spiral. The coils of the spiral are more rapidly ascending than they are at the base. Towards the apex the hooks grow somewhat smaller. There is a slight difference between the hooks of opposite sides of the proboscis immediately above the basal part. On the outer side—that is, the side which bears the large basal hook—they are small, short, rather stout, sharply recurved, and about

0.005mm in length, or one-eighth the length of the large hook. On the opposite side they are slender, slightly recurved, and about 0.015mm in length.

The narrow crimson band at the base of the contractile bulbs is 0.02mm wide, and occupies the entire breadth of the body. The elongated rod-like segments which immediately precede the mature segments contain a double row of large, elliptical bodies, lying one on each side of the median line. The cirrus is smooth, slender, of moderate length, and opens about the middle of the margin of the segment. The interior of the mature segments is filled with the very numerous ova.

This *Rhynchobothrium* is evidently the adult form of a species either identical with the larval *Rhynchobothrium* from *Cepola rubescens* figured by Wagener (Nov. Act., Nat. Cur., XXIV, Suppl. 48 and 82, Plate XIX, 230–234), or at least closely related to it.

The figure of the proboscis given by Wagener shows the same remarkable peculiarities which characterize this species. The shape of the bothria, the proportions of the head, neck, proboscides, contractile bulbs, as shown in Wagener's figures, agree with these specimens from *Trygon centrura*. Wagener does not give a specific name to the larval form. He simply designates it as "A *Tetrarhynchus* from *Cepola rubescens*."

So far as I am aware, the adult has not been found. I therefore propose, as a proper specific designation for this species, the name *R. wageneri*, in honor of the original describer of what is probably the larval form of the species.

35. *Rhynchobothrium lomentaceum* Dies.

[Plate XIII, Fig. 1–3.]

Diesing, Syst. Helm., I, 571; Révis. des Cepth. Par., 290. Von Linstow, Comp. Helm., 280.

I refer a single *Rhynchobothrium* from *Mustelus canis* to Diesing's *R. lomentaceum* from *M. vulgaris*. This is done with some hesitation, for, although it does not disagree with Diesing's description, the latter is confined to such general characters that specific differences might still exist between my specimen and *R. lomentaceum*. It should also be remarked that the armature of the proboscides resembles very closely that of *R. caryophyllum* Dies. from *Scoliodon lalandii*. (Denks. der kais. Akad., XII, 30, Plate IV, figs. 16–20.)

Diesing gives the following description of *R. lomentaceum:*

Head with oval, lateral bothria converging at the apex. Neck slightly depressed. Body lanceolate, first segments very short, transversely oblong, each with rounded margin and swollen in the middle. Genital apertures. . . . Length of head and neck, 4mm; length of body, 36mm; breadth of posterior, 4mm.

My specimen consists of the head, neck, and a few of the first segments, the whole measuring, when living, 9mm. There is also a fragment containing a number of median segments and measuring, when

living, 10.5mm. The last segment of this fragment was 1.1mm long and 1.7mm broad. The length of the head and neck in the living specimen was 3.5mm; length of contractile bulbs 1mm.

Following are dimensions of the alcoholic specimen: Length of head 1.44mm, breadth 1.66mm; length of bothria 1.60mm, breadth 0.92mm; length of head and neck, 3.14mm; diameter of neck, marginal, 1.10mm, lateral 1mm; length of contractile bulbs 1.08mm, breadth 0.26; distance from base of bulbs to first distinct segment, 3mm; length of first distinct segment 0.16mm, breadth 1.20mm; greatest breadth of segments 1.80mm, length 0.80mm; lateral diameter behind bulbs, 0.90mm; marginal diameter, 0.56mm; diameter of proboscides, 0.12mm.

The following description is based on the single alcoholic specimen: Head broadly sagittate. Bothria two, oval, narrow in front, broad behind, with thick, entire edges, a very faint emargination on posterior edge, converging at apex of head, flaring posteriorly, so as to give to the head the shape of an equilateral triangle. Neck a little longer than head, swollen in front of contractile bulbs, fusiform on account of contraction in length, slightly constricted at base of contractile bulbs. Proboscis sheaths spiral, contractile bulbs four times as long as broad. Proboscides longer than bothria; hooks of two principal sizes, the larger ones stout, broad, and strongly recurved, the smaller ones also broad and strongly recurved, but some of them proportionally more slender than the larger ones, a few slender and arcuate. Larger hooks on outer side of proboscides, smaller ones on inner side. First segments very short and broad; succeeding segments also short and broad, with rounded margins; margins of segmented part of strobile crenulate.

Male genital aperture marginal, about middle of segment.

Habitat.—Mustelus canis, spiral valve, one specimen. Wood's Holl, Massachusetts, August 11, 1887.

The only details that the small amount of material at hand permits relate to the disposition of the hooks on the proboscides. The largest hooks are 0.04mm in their greatest length, and 0.02mm broad at base. The smaller hooks are from 0.01 to 0.02mm in length, and from 0.004mm to 0.01mm in breadth. The spiral series of hooks are 0.035mm apart, and the hooks in each series are situated from 0.01mm for the larger to 0.02mm for the smaller from each other. The arrangement seems to be as follows: On the outer side of the proboscis there are four longitudinal rows of large, strongly recurved hooks. On the opposite or outer side there are four longitudinal rows of hooks, much like the large hooks in shape and proportion, but having only about half their lineal dimensions. The series of large hooks is flanked on each side by two rows of hooks which are somewhat smaller and proportionally a little more slender than the large hooks. Between each of these two series of intermediate hooks and the inner series of small hooks there is a single row of hooks consisting of alternately large and small hooks.

The larger of these two styles of hooks are, however, small-sized, and correspond, both in shape and size, to the hooks in the inner series. The smaller alternates of this row are but slightly recurved. The larger alternates are about 0.017^{mm} long and 0.008^{mm} broad at base; the smaller ones are 0.011^{mm} long and 0.005^{mm} broad at base. To recapitulate, there are four rows of large hooks on outer side of proboscis, four rows of small hooks on inner side, two rows of intermediate hooks on each side of the series of large hooks, one row of alternately larger and smaller hooks on each side of the series of small hooks, thus making fourteen rows in all. All the hooks are smaller and more slender near the base of the proboscis.

The fragment of strobile which was found associated with the scolex, and which evidently belongs to it, does not contain any mature segments. The posterior segments are somewhat elongated and are narrower than the preceding segments. None of the genital organs could be made out except the cirrus, which could be seen through the walls of the segment when the latter were rendered transparent with glycerine. The male genital aperture is marginal about the middle. The walls of the segments are traversed by many strong, longitudinal, muscular fibers.

36. *Rhynchobothrium longicorne*, sp. nov.

[Plate XIII, Figs. 4–8].

Head appressed, truncate, and emarginate in front. Bothria two, lateral, oblong-elliptical, parallel in front, slightly divergent behind, slightly emarginate on posterior edge, somewhat bilobed by a low, short, longitudinal, median ridge near the posterior end of the shallow face. Neck long, but capable of great contraction, subcylindrical. Proboscides very long, three or four times as long as the bothria, tapering to apex, with tumid basal portion covered with fine, slender, straightish appressed hooklets; remainder of proboscis armed with longer, slender, curved hooklets of nearly uniform size. Proboscis-sheaths very long, in contracted specimens lying in broad, crowded, sinuous folds. Contractile bulbs elliptical or elliptical-oblong. Segments begin very soon behind contractile bulbs; at first very short, subsequently increasing in length, then becoming as long as broad; last segments rectangular, longer than broad. Body relatively short, compressed, at first a little wider than neck and increasing in breadth but little throughout its length.

Genital apertures male marginal, near anterior edge, its position in some specimens marked by an evident notch; female lateral at middle point of median line (?). Eggs oval about 0.04^{mm} in longer diameter.

Habitat.—Odontaspis littoralis, spiral valve. Wood's Holl, Massachusetts, July, 1885; August, 1886.

I have found this species on two different occasions, each time in the sand shark (*Odontaspis littoralis*). The first specimens, three in number, were collected July 15, 1885; the second, four in number, August 12, 1887.

In the following, No. 1 was a living specimen somewhat flattened under the compressor; Nos. 2 and 3 alcoholic. Nos. 1 and 3 are doubtless the same individual.

Dimensions.	No. 1.	No. 2.	No. 3.
	mm.	*mm.*	*mm.*
Length	14.00	8.50	10.00
Length of bothria	2.00	0.92	1.23
Breadth of bothria	.....	0.66	0.80
Length of head and neck	5.20	2.80	3.10
Diameter of neck	.....	0.46	0.52
Length of contractile bulbs	1.06	0.80	1.04
Diameter of contractile bulbs	0.34	0.16	0.18
Length of proboscis	6.40	.....	.....
Distance from base of bulbs to first segment	0.80	0.60	0.60
Length of first distinct segment	0.10	0.10	0.10
Breadth of first distinct segment	1.00	0.68	0.60
Length of last segment	2.20	1.20	1.56
Breadth of last segment	1.40	0.86	1.04
Number of segments	24	16	24

In No. 1 the last 17 segments show the reproductive organs.

From a specimen collected July, 1885, the following measurements were obtained: length of head, 3^{mm}, breadth, 2^{mm}; length of neck, 6^{mm}; breadth, 1.3^{mm}; length of contractile bulbs, 1^{mm}, breadth, $0{\cdot}5^{mm}$; length of posterior segment, 4^{mm}, breadth, 2.5^{mm}.

Some dimensions of proboscides and hooks are: diameter at base, excluding hooks, 0.097^{mm}; including hooks, 0.1^{mm}; median diameter, excluding hooks, 0.066^{mm}; including hooks, 0.102^{mm}; length of hooks on base of proboscis, 0.02 to 0.03^{mm}; breadth, 0.004^{mm}; length of median hooks, 0.04^{mm}, breadth, 0.007^{mm}.

The tumid base of each proboscis is prominently shouldered on the outer side. In this respect it resembles *R. wageneri*. There is, however, no single large hook as in that species, and besides there is a very great difference between *R. wageneri* and *R. longicorne* in respect to the conformation and arrangement of the hooks.

Behind the basal enlargement the hooks are nearly straight, appressed closely to the surface of the proboscis, slender, sharp-pointed, and, many of them, with a single short lateral basal prolongation. The spirals are about 0.01^{mm} apart, while the longest hooks are over 0.03^{mm} in length. The points of the hooks in one spiral therefore cover the bases of the preceding series. The hooks on the outer side of this part of the proboscis are larger than those on the inner side. On the anterior part of the basal enlargement of the proboscis they are smaller and crowded together closely. The spirals are here about 0.005^{mm} apart, and twenty-five hooklets and over may be counted in a single transverse spiral. There is some variety in the shape of the hooks on the basal enlargement. On its outer part they are, in the main, straight and slender. Toward the inner side on the anterior slope there are about five spiral series in which the hooklets are placed close together side by side. These hooklets stand

nearly erect, are moderately broad and abruptly recurved at the point. In front of the basal enlargement the hooks are, in the main, slender, sharp-pointed, and arcuate, from 0.022^{mm} to 0.033^{mm} in length, the spirals about 0.02^{mm} apart, about eight hooklets visible in each spiral. The hooks, for the most part, are nearly erect. There are, however, on one side of the proboscis, two longitudinal rows of hooks, which are stouter than the hooks in the other longitudinal rows, and are strongly appressed, the hooks in each row pointing toward the other row. This arrangement seems to be very similar to that figured by Van Beneden for his *Tetrarhynchus minutus* from *Squatina angelus*. These two rows of appressed hooks are flanked on the one side by a row of rather short broad-based hooks, strongly recurved, and on the other by a row of rather short arcuate hooks. The remaining hooklets do not differ from each other either in size or shape. They are long, slender-pointed, arcuate, nearly erect, and impart a characteristic bristly appearance to the proboscis. The proboscides taper gently toward the apex, where there is much less diversity both in size and shape of hooks than there is farther back.

The lateral vessels of the water vascular system remain plainly visible in an alcoholic specimen lightly stained with hæmatoxylon. The body is short, broad, and much flattened. In the mature segments the ova are collected in a mass at the bottom of an elongated clear space, which begins at the marginal genital aperture near the anterior end, runs directly to the median line, follows the latter to near the posterior end, where it expands into the cavity in which the ova are lodged. The cirrus was not observed. I have not been able to demonstrate the position of the female genital aperture in the alcoholic specimens, but am disposed to think that it is lateral, from the fact that, in a living specimen, there were distinct median lateral apertures on the squarish segments in front of the mature segments.

Otobothrium, gen. nov.

[οὖς, ὠτός, the ear.]

Body articulate, tæniæform, head separated from body by a neck. Bothria two, opposite, lateral, each with two supplemental ciliated pits at the posterior free angles. Proboscides four, terminal, filiform, armed, retractile in neck. Reproductive apertures marginal.

According to Diesing's classification this genus belongs to the subtribe *Trypanorhyncha* and the family *Dibothriorhynchidæ*. The number of the bothria allies it with the genus *Rhynchobothrium*. On the other hand the neck of *Otobothrium* bears a close resemblance to that of *Tetrarhynchus*. The reason for separating it from *Rhynchobothrium* and erecting it into a new genus is found in the presence of the four otosacs or ciliated pits. These, if not homologous with the supplemental disks of *Calliobothrium*, etc., certainly furnish a character of as much weight in classification as they.

37. *Otobothrium crenacolle*, sp. nov.

[Plate XIII, Figs. 9-15, and Plate XIV, Figs. 1-4.]

Head broad, transverse, hammer-shaped, or, in alcoholic specimens, bluntly rounded in front and cordate, compressed. Bothria two, opposite, lateral, sub-rectangular or oblong-elliptical, bilocular, slightly emarginate on posterior edge, converging in front, widely divergent behind; each bothrium with two eversible, ciliated pits at the posterior edge. Faces of bothria hollowed out, edges somewhat thickened. Neck short, cylindrical, slightly compressed, broader, and much thicker than anterior part of the body, from which it is quite distinct, posteriorly projecting into a kind of collar with four deep notches opposite the sides and margins of the body. Proboscides slender, about twice the length of a bothrium, armed, for the most part, with strongly recurved hooklets, which are sharp-pointed with broad bases of uniform size and symmetrically disposed; about five visible at once in each of the diagonal rows. There are beside these some minute slender hooklets near the base of the proboscides. The proboscis-sheaths are spiral. The contractile bulbs are short, oval, and lodged at the base of the neck in the projecting lobes made by the posterior notches of the neck. The body is slender, compressed, and much narrower at first than the neck. First four segments very short, three or four times as broad as long. The remaining segments increase in length, rapidly becoming very long and slender, the posterior segment often from twelve to fifteen times as long as broad. Free proglottides slender, somewhat irregular in outline, very active. Ova subglobular, abundant. Genital apertures, at least male, marginal a little behind middle point.

Habitat.—*Sphyrna zygæna*, spiral valve, July 28, 1886, one hundred and fifty specimens; July 18, 1887, one hundred specimens; chyle swarming with free proglottides on both occasions. Wood's Holl, Massachusetts.

Numbers 1 and 2 of the following are from living specimens; 3 and 4, alcoholic.

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length	11.20	10.80	11.50	14.00
Length of bothria	0.22	0.22	0.20	0.22
Breadth of head	0.32	0.32	0.30	.....
Length of head and neck	0.36	0.40	0.36	0.36
Diameter of neck	0.12	0.12	0.14	0.14
Diameter of neck at contractile bulbs	0.16	0.16	0.18	0.18
Length of contractile bulbs	0.10	.....	0.08	0.06
Breadth of contractile bulbs	0.05	.....	0.05	0.04
Breadth of first segments	0.08	0.10	0.10	0.12
Length of last segment	1.90	2.40	3.00	3.30
Breadth of last segment	0.28	0.20	0.36	0.30
Number of segments	16	18	17	20

The following details are taken from a living specimen slightly distorted under the compressor: Length, 9.30 mm; length of head and neck, 0.36 mm; breadth of head, 0.32 mm; length of bothria, 0.17 mm; diameter of neck, 0.10 mm; diameter at contractile bulbs, 0.13 mm; length of each of first four segments, 0.02 mm; breadth, 0.07; length of fifth segment, 0.04 mm; sixth, 0.08 mm; seventh, 0.12 mm; eighth, 0.16 mm; ninth, 0.30 mm; tenth, 0.44 mm; eleventh, 0.60 mm; twelfth, 1. mm; thirteenth, 1.25 mm; fourteenth, 1.8 mm; fifteenth, 3 mm. The last of these segments were 0.10, 0.14, and 0.2 mm broad, respectively.

The length of the proboscides, estimated from specimens that had been made transparent, so as to show the retracted proboscides, seems to be from 0.5 to 0.6 mm. The longest everted proboscis measured 0.4 mm; diameter, excluding hooks, 0.011 to 0.016 mm; including hooks, 0.019 to 0.025 mm; length of hooks, 0.007 to 0.008 mm; breadth 0.003 mm; length of minute hooks at base of proboscides, 0.003; breadth, 0.001 mm; length of free proglottis, living, 4.4 mm; breadth, 0.8 mm.

In alcoholic specimens the bothria are invariably opposite and divergent at the bases, so as to give to the head, when viewed laterally, marginally as to body, a cordate or even reniform outline. The outline of the head and neck together is like that of a hammer, in which the neck represents the short thick handle. The head is only about half as thick as it is wide, *e. g.* in an alcoholic specimen the breadth of head was 0.28 mm; thickness, 0.14 mm; in this specimen the length of a single bothrium was 0.2 mm; its breadth, 0.14 mm. In another specimen the head was 0.32 mm broad and 0.14 mm thick.

In the living worm the faces of the bothria are frequently directed forward, and when viewed in this position their anterior edges are seen to be separated by a moderately wide space. A pair of proboscides emerges from the anterior edge of each bothrium. There is a slight emargination on the anterior edge of each bothrium, and another shallow emargination on the posterior edge. A median line extending from the shallow posterior notch to the front edge divides the bothrium into two loculi. This latter feature is often lost, or at least much obscured, in alcoholic specimens, in which the faces of the bothria are deeply concave, the lips sometimes much inflexed.

Supplemental pits or otosacs.—These organs appear under low magnifying power as four round spots, lying one at each of the posterior angles of the two bothria. When highly magnified, 250 to 300 diameters, these spots are seen to be oval or conical pits, lined with minute ciliary bristles, and about 0.025 mm in diameter. While examining one of these pits with a magnifying power of about 300 diameters, the specimen was subjected to a slightly increased pressure, when one of the pits was observed to evert itself, changing from an oval pit lined with ciliary bristles to a blunt conical papillary elevation, which was covered with erect bristles. In the alcoholic specimens some of these pits are everted into low papillæ. These remarkable pits are strongly suggestive of low

or rudimentary sense organs. A careful histological examination of the scolex may throw some light on their true nature.

Anatomy of mature segments.—The male genital aperture is marginal a little back of the middle. A lateral aperture was observed in a few free segments. It was situated near the anterior end of the segment, and is probably an opening for the discharge of ova, since careful search failed to reveal any corresponding opening on immature segments. The cirrus was not seen fully everted. The length in an alcoholic specimen was estimated to be about 0.6^{mm}, and the diameter at base 0.12^{mm}. It emerges from the center of a comparatively wide but shallow marginal notch. The vagina appears to open immediately behind the cirrus in the same marginal notch. The cirrus bulb is rather small, oval, and directed slightly forward. The vas deferens lies in a coil in front and at the base of the cirrus bulb, and enters the base of the bulb. The ovaries are small oblong, or oval, and lie one on each side of the median line and at about one-third the distance from the genital aperture to the posterior end of the segment. Back of the ovaries are a number of oval clear spaces.

The ova are nearly globular. A living ovum measured 0.024 and 0.022^{mm} in its two diameters. Ova in the preserved specimens, mounted in glycerine and slightly compressed, appear almost globular, and are 0.027^{mm} in diameter. They have smooth and rather thin shells, which must be quite rigid, as no eggs were observed with the shell collapsed or indented. In a few cases the ova are aggregated into a globular mass about the middle of the segment and a little in front of the genital aperture. This mass causes an abrupt swelling in the walls of the segment, which, upon slight pressure, bursts, releasing the eggs in vast numbers. Ova were also seen lying along the median line and in small clusters near the anterior end, whence they apparently find their natural outlet.

The anterior part of the mature segments which do not yet contain ova is filled with oval or elliptical bodies, which, according to analogy with other forms, doubtless represent the testes. In some these have disappeared along the median line, leaving a median sinus which evidently becomes a receptacle for ripe ova. There are usually only from 12 to 15 segments present in a single specimen. As the segments mature they separate easily.

On both occasions of finding this worm the chyle of the intestine was swarming with them and with the free proglottides. A few were found in the pyloric division of the stomach. The free proglottides, when placed in sea-water, continued very active for several hours. They were capable of active progressive motion by alternate contraction, and expansion of the body, during which each end often assumed the shape and performed the function of a sucker. The masses of ova in the living proglottides were, in some cases, ivory-white and opaque. In others they passed from white through yellowish to brown. Others were yellowish green.

I have had the opportunity of examining but two specimens of the hammer-head shark (*Sphyrna zygæna*). These were obtained in different years, and both yielded this parasite in abundance. The only other parasites found in this host were a single Nematod in the spiral valve of one, and a few cysts (Xenosites) in the muscular coats of the stomach of each.

Subfamily II.—Tetrabothriorhynchinæ.

Family *Tetrabothriorhynchidæ* Dies.

TETRARHYNCHUS Rudolphi.

Bothriocephali spec. Bartels.
Rhynchobothrii spec. Van Beneden and R. Leuckart.
Tetrarhynchi spec. Van Beneden.
Aspidorhynchus Molin.
Tetrarhynchobothrium Dies.

Body articulate, tæniæform. Neck tubular. Head with four bothria in two lateral pairs, parallel with the head. Proboscides four, terminal, filiform, armed, retractile in the neck, free, *i. e.*, not running through the bothria. Genital apertures marginal or lateral.

38. *Tetrarhynchus tenue*, sp. nov.

[Plate XIV. Figs. 5, 6.]

Head variable, but often sagittate. Bothria four, in two lateral pairs, long-oval, long-elliptical, or oblong. Proboscides four, somewhat quadrangular, a little shorter than the bothria, densely beset with very slender straightish or slightly arcuate spine-like hooklets, which are of nearly uniform size and shape. The proboscides emerge from a point a short distance back of the apex of the head. Neck tubular, contractile. In life it may be twice as long as the bothria, but in alcoholic specimens it is usually shorter than the bothria. Posteriorly it is continued in a collar which incloses the anterior part of the body. It is ordinarily broader than the anterior part of the body. The proboscis sheaths are nearly straight, with the exception of a single spiral kink in front of the contractile bulbs. The latter organs are short-oval—in alcoholic specimens less than one-third the length of the bothria. The segments begin immediately behind the neck as fine transverse wrinkles. The first distinct segments are very short, subsequently increasing in length, becoming squarish, then longer than broad. The posterior mature segments are considerably longer than broad, with a tendency, in alcoholic specimens, to become convex on the margins, thus giving a decidedly repand outline to the margins of the mature portions of the strobile.

Genital apertures: male, marginal, a little in front of the middle point. Cirrus rather short and smooth; female aperture lateral (?). Ova small, spheroidal, escaping from lateral aperture. General habit of body more slender, especially head and anterior part of body, than *T. robustum*.

Habitat.—Trygon centrura, stomach and pylorus. August, 1884 and 1887. Wood's Holl, Massachusetts.

Upon four different occasions I have obtained a few *Tetrarhynchi* from the stomach of the sting ray (*Trygon centrura*), which, with the somewhat hurried examination that was made of them while they were alive, were supposed to belong to the same species. After an examination of the alcoholic specimens, however, I find that there are two entirely distinct species in each of the four lots. These differ from each other most in the character of the hooklets on the proboscides, *T. tenue*, having minute spinose hooklets, while the hooklets of *T. robustum* are short, stout, and strongly recurved.

These parasites were found as follows:

Date of capture.	No. of rays examined.	No. of parasites found.
August, 1884	One	One.
August 1, 1887	Three	Two.
August 8, 1887	One	Three.
August 10, 1887	Two	One.

These specimens were all found either in the stomach proper or in the pylorus.

Of the following measurements No. 1 was a living specimen, the others alcoholic:

Dimensions.	No. 1.	No. 2.	No. 3.
	mm.	*mm.*	*mm.*
Length	19 00	20. 00	13. 50
Length of bothria	0. 46	0. 36	0. 40
Breadth of head	0. 30	0. 24	0. 26
Length of head and neck	.....	0. 56	0. 48
Diameter of neck	0. 24	0. 18	0. 20
Length of contractile bulbs	0. 14	0. 11	0. 12
Breadth of contractile bulbs	0. 05	0. 05	0. 04
Length of proboscides	.....	0. 28	0. 20
Diameter of proboscides	.....	0. 02	0. 026
Length of hooklets	.....	.....	0. 0055
Breadth of hooklets	.....	.....	0. 0014
Length of anterior segment, approximate	0. 04	0. 02	0. 02
Breadth of anterior segments	0. 18	0. 12	0. 16
Length of posterior segments	1. 16	0. 88	0. 80
Breadth of posterior segments	0. 70	0. 58	0. 24

In No. 1 the diameter of neck at collar was 0.18^{mm}; length of neck proper, 0.40^{mm}; length of collar, 0.14^{mm}; length of bothria, varying from 0.36 to 0.56^{mm}; posterior segments, from 0.94 to 1.16^{mm}.

In an alcoholic specimen, 13^{mm} in length, the length of the head and neck was 0.78^{mm}; in another, 17^{mm} in length, the length of the head and neck was 0.48^{mm}.

I take the following descriptive paragraph from notes made at the time of collecting: Bothria elongated in two lateral pairs, the bothria constituting a single pair united at the apex, each with an irregularly hollowed face and posterior bluntly rounded edges reflexed from the neck. Anterior part of head projecting about 0.1^{mm} in front of the bases of the proboscides, the latter shorter than the bothria. Neck short, tumid, constricted behind the short contractile bulbs and continued posteriorly into a collar which surrounds the anterior part of the body. The body is joined to the neck at the base of the bulbs. Fine transverse lines begin at once behind the collar. The first segments are broader than long. They increase in length rapidly and at a distance of 8^{mm} from the head are more then twice as long as broad. The posterior mature segments are somewhat irregular in outline and tumid in the middle. When placed in water the ripe segments are apt to burst at the middle of a lateral face, by means of a rapid papillary swelling from which the eggs escape. Under the compressor the dividing line between the ripe segments is indistinct.

The spheroidal ova measure about 0.019 and 0.014^{mm} in the two diameters. Some are nearly spherical and 0.019^{mm} in diameter.

The epidermis of one specimen exhibited a tendency to slough off after lying for a short time in sea-water. In some specimens, after having been placed in sea-water, it was observed that the mature segments had curved towards one of the lateral faces, burst about the middle, and discharged ova in such quantity as to leave a milky white patch at the bottom of the dish.

When alcoholic specimens were highly magnified the apex of the head and the edges of the bothria are seen to be densely covered with minute hair-like bristles, which are a little longer than the hooklets of the proboscis. These bristles belong to the epidermis, are easily rubbed off, can be seen only with a high magnifying power and hence may be easily overlooked.

In the mature segments the nearly spherical ova lie in scattered masses. These small aggregations are probably what remain of the ova, the greater part having escaped through the lateral aperture. The cirrus emerges near or a little in front of the middle point of the margin, thus differing from *T. robustum*, in which the cirrus opens near the anterior margin.

This species has many characters in common with *T. infulatum* (*Aspidorhynchus infulatus* Molin).

39. *Tetrarhynchus robustum*, sp. nov.

[Plate XIV, Figs. 7–9.]

Head bluntly rounded in front. Bothria four, oblong, hollowed out on the face, with flexible borders, distinctly arranged in lateral pairs, the bothria in each pair approximating at their fore posterior edges. Neck variable, usually cylindrical, broader than anterior part of body,

continued posteriorly into a collar which incloses the anterior part of the body, in alcoholic specimens often transversely wrinkled. Proboscides nearly equaling the bothria in length, armed with short, strongly recurved hooklets, sheaths nearly straight with a single spiral turn immediately in front of the contractile bulbs. The latter are long-oval, and a little more than one-half as long as the bothria. The body begins immediately behind the contractile bulbs, and is at once crossed by transverse lines which soon outline distinct segments. The first segments are very much broader than long. Subsequently they increase in length slowly, the posterior mature segments becoming at first squarish, then a little longer than broad. Male genital apertures marginal, irregularly alternate, near anterior edge. Cirrus small, smooth; cirrus bulb slender. Female genital aperture lateral(?).

Ova small, very abundant, nearly spherical, about 0.016^{mm} in diameter, and with a thin shell.

Habitat.—*Trygon centrura*, stomach and pylorus, August, 1884 and 1887, Wood's Holl, Massachusetts.

The general habit of *T. robustum* is stouter than *T. tenue*. The head, neck, and segments are relatively broader; the head is more blunt at the apex; the proboscides emerge from the apex of the head instead of a little way back of the apex; the hooklets on the proboscides are much stouter and more sharply recurved; the contractile bulbs are longer; the cirrus opens near the anterior end of the segment instead of near the middle.

I have found this species associated with *T. tenue*, as follows: August, 1884, two specimens; August 1, 1887, two specimens; August 8, fragments; August 10, one specimen.

The following measurements were obtained from alcoholic specimens:

Dimensions.	No. 1.	No. 2.
	mm.	*mm.*
Length	20.00	24.00
Length of bothria	0.68	0.60
Breadth of head	0.70	0.64
Length of head and neck	1.20	1.18
Diameter of neck	0.50	0.42
Length of proboscides	0.60	0.60
Diameter of proboscides	0.03	0.03
Length of hooklets	0.011	0.014
Breadth of hooklets	0.005	0.005
Length of contractile bulbs	0.33	0.32
Breadth of contractile bulbs	0.10	0.08
Length of anterior segments, approximate	0.02	0.02
Breadth of anterior segments	0.38	0.40
Length of posterior segments	0.52	0.86
Breadth of posterior segments	0.96	0.80

The hooklets are nearly uniform in shape, which is much like that of the claw of a cat. The breadth of base equals about half the length. At

the base of the proboscides the hooklets have only about half the linear dimensions of those at the middle and near the apex. They are similar in shape except perhaps a little more recurved at the point. The hooklets are arranged in uniform spirals, which are about 0.017^{mm} apart. Seven hooklets can be seen in each spiral on one side of the proboscis.

The proboscides bear some resemblance to those of *T. bisulcatum* (*Rhynchobothrium bisulcatum* of my former paper), but are much smaller, being about half the diameter, and the hooks are about half as long. The hooks are also relatively more slender. The head and neck of *T. robustum* also resemble that of *T. bisulcatum*, but are not so plump. The edges of the bothria were covered with fine capillary bristles as in *T. tenue*. They were, however, not so abundant, nor were they observed at the apex of the head.

The segments in all but one of the specimens that I have yet seen were much broader than long. In one, the posterior segments to the number of ten or twelve, are squarish, and the last two or three a little longer than broad. The cirrus bulb in the mature segments extends from the marginal aperture, near the anterior edge, half the distance or more to the median line, and inclined forward toward the anterior edge. The vas deferens shows plainly, lying in voluminous coils at the base of the bulb and along the median line. The ovary is a broad two-lobed organ centrally placed. The ova lie along the median line. There yet remains much to settle with respect to the disposition of the genitalia of these segments which I have not yet studied from thin sections.

40. *Tetrarhynchus bisulcatum* Lt.

[Plate XIV, Figs. 10–12, and Plate XV, Fig. 1.]

Rhynchobothrium bisulcatum Lt. Report of U. S. Commission of Fish and Fisheries for 1886, pp. 479–486, Plate IV, Figs. 9–23.

In my original description of this species I regarded the bothria as two in number, but distinctly bilobed. Since writing the first description I have had an opportunity to study living specimens and have decided to refer the species to the genus *Tetrarhynchus*. I was perhaps misled by the close resemblance to Van Beneden's figures of *Tetrarhynchus lingualis* Cuv. (*Rhynchobothrium paleaceum* Rud. and Van Ben., Diesing, Revis. Ceph. Par., 294).

The only emendation necessary in the original description is to change from "bothria two, divided into two distinct lobes," to bothria four, arranged in two lateral pairs. Also the female genital aperture is marginal, beside cirrus.

On the 25th of July, 1887, I obtained from the pyloric division of the stomach of a dusky shark (*Carcharias obscurus*) a large lot of this species. There were about four hundred of these parasites crowded into a space of 8 or 10 inches in the narrow pyloric constriction of the stomach. A portion of this part of the alimentary canal cut open so as to

show the worms attached; is shown in Fig. 1, Plate xv. The bodies of the living worms were very much crumpled and folded and the heads and anterior segments were buried in the walls of the pylorus. On this account they were very difficult to remove. Usually the scolices were buried together in groups of from three to six or more in a common cavity. These cavities or pits extended through the mucous and submucous coats into the muscular layers. The heads of many of the specimens were yellowish green, and nearly all were characterized by having a greenish band at the base of the neck or a greenish tubular neck.

In my former description I recognized three distinct varieties. In this lot the same varieties can bē distinguished with, perhaps, a greater tendency to intermediate forms. A living specimen, with mature segments and measuring only 32^{mm} length, agrees in all essentials with var. *α*. Two others, which were quite long and slender, measuring 280 and 330^{mm}, respectively, answer, in the main, to the conditions established for var. *β*.

In general the specimens were not much changed by immersion in alcohol, hence the measurements already published for this species need not be added to in these notes.

An interesting abnormal form was found in this lot. It consisted of two slender but distinct strobiles with a single scolex. The strobiles measured 25 and 65^{mm}, respectively. This does not seem to be a mutilated specimen, since the two strobiles are distinct as they emerge from the cervical collar. The segments do not begin at once, and when they do they make their appearance at different distances from the head. The segments on the latter half of the longer chain agree in outline with those of var. *β*. The cirrus is quite distinct and emerges near the middle of a margin, or a little in front of the middle and runs thence diagonally to the anterior edge at the median line. There is no sign of lateral apertures. The posterior segment is 0.76^{mm} long and 0.66^{mm} broad.

In this species, in general, the cirrus emerges near the margin not far from the anterior edge of the segment. The only exception that I have noticed is in the case of some individuals of variety *β*, where the cirrus emerges not far from the middle of a margin. In all cases, however, the cirrus and its bulb extend from the marginal opening inward and forward until its base reaches almost to the anterior edge of the segment at the median line. The cirrus is slender, smooth, and tapering.

Anatomy of scolex.—I have not yet made a careful histological study of this species, but in endeavoring to settle some points in the anatomy of the mature segments I found it necessary to make thin sections of a few segments, and at the same time stained a scolex with carmine and cut it into transverse sections.

The muscular walls of the contractile bulbs are of surprising thickness. The bulbs lie close together, the limiting membrane of one fusing

with that of the other at the point of contact. The inner cavity, as shown in these sections, is very small, being, in fact, but little more than twice the diameter of the retractor muscle which it contains. The cavity instead of being central is really at one side. In each case it is at a side which adjoins one of the other bulbs, but so disposed that each of the four cavities lies at one of the partitions which separate the bulbs from each other. The thick wall of a bulb is composed of several, in some places as many as six or seven, alternating layers of muscular fibers, whose cut ends show that they run in alternating spiral directions from one end of the bulb to the other. The layers are rather thick, in some cases at least being equal to the diameters of a dozen fibers. The retractor muscle, which is itself made up of a number of parallel fibers, is usually oblong or elliptical in section, but sometimes nearly circular.

The following maximum dimensions show the proportions of these parts:

	mm.
Diameter of the bulb	0.158
Diameter of inner cavity of bulb	0.039
Diameter of retractor muscle	0.019
Thickness of muscular wall of bulb	0.111

Sections made near the anterior end of the head reveal a very dense tissue throughout. They are divided into quadrants by two bands of transverse fibers which bisect each other at the center. Toward the outer edge these transverse fibers become indistinct amidst the denser tissue of the outer part of the head. In each of the quadrants thus formed one of the proboscis sheaths lies. The walls of the sheaths are made up for the most part of fine circular fibers. In some of the sections the sheath, the proboscis, and the retractor muscle of the latter could be plainly seen. The walls of the proboscides are thicker than those of the sheaths, and like them are composed of circular fibers. The sheaths are accompanied on all sides, except that which is turned toward the central axis of the scolex, with strong longitudinal muscular fibers.

Near each sheath on the inner side, or rather between each sheath and the point at which the transverse bands of fibers cross, there is an irregular circular cluster of granules. They indicate the presence of longitudinal vessels, of whose exact nature I am not certain. They are stained deeply by the carmine, and are quite different in appearance from the cut ends of longitudinal muscle fibers. Towards the base of the sheaths these vessels have a distinct limiting membrane. Their cross-sections, in the mean time, become somewhat circular. They now lie close to the proboscis-sheaths. They follow the proboscis-sheaths to the anterior ends of the bulbs, where they disappear. I am inclined to regard them as nervous vessels.

In the sections behind the bulbs the tissues appear rather spongy, with longitudinal fibers interspersed. Towards the circumference there

is a predominance of circular fibers, which form an indistinct layer and in which a division presently takes place, the outer part and the granular tissue which is outside of it sloughing off to form the collar. Part of the circular layer then goes to form the outer cuticular layer of the body and another part goes to form the inner cuticular layer of the collar. In sections made through the anterior part of the body, still within the collar, the latter now appears as a concentric circle of dense granular tissue with a few circular fibers. The tissues of the body proper are, first, a thin cuticular layer; then a thick layer of spongy tissue with irregular open spaces and a few longitudinal fibers interspersed; next a layer of longitudinal fibers, into which most of the longitudinal fibers of the neck are now collected. This layer is about 0.027^{mm} thick, and surrounds a central core which is about 0.324^{mm} long, from margin to margin, and 0.035^{mm} broad.

Sections of longitudinal vessels lie at the marginal extremities of the central core. Of these there are three principal ones near each margin. Two of these, at each margin, have definite outlines; the other, at least at first, is somewhat indefinite. In some sections they are oblong, the largest about 0.01^{mm} in diameter; in others they are nearly circular and as much as 0.016^{mm} in diameter. These longitudinal vessels appear first in sections immediately behind the contractile bulbs, before the inner core is differentiated.

Anatomy of posterior segments.—In my former account of this species I stated that the female genital aperture is lateral. In this I was mistaken, being misled by the median lateral aperture for the escape of ova. A few segments were stained and cut into thin sections. In them the vagina was traced from the ovary forward along the median line, where it lay as a small tube, with short sinuous curves, to the base of the cirrus bulb. It there turns abruptly towards the margin, and in some can be traced for a short distance behind the cirrus bulb. It very soon passes to the side of the bulb, and consequently in longitudinal sections disappears from view. The cirrus emerges not exactly on the margin but a little way from the margin. The vagina appears to open immediately beside the cirrus, between it and the margin, or, what is more probable, the vagina and cirrus have a common marginal cloaca. In some sections, which passed diagonally through the segment, the tube of the vagina was seen lying close beside the cirrus bulb and near its outer extremity. The cirrus, in these sections, is seen as a slender, convoluted tube lying in the elongated bulb. The vas deferens is a much convoluted tube, which lies in an irregular or pyriform mass in front of the ovary. It enters the base of the cirrus bulb near the anterior edge of the segment. The ovary is centrally situated, about .36^{mm} broad and .16^{mm} long. In some of the sections it seemed to be made up of elliptical lobules, each containing a number of polygonal, often nucleated cells, each of the latter about .008^{mm} in diameter.

In segments which did not contain ova the walls are quite muscular.

They consist of an outer layer of fine muscular fibers crossing the longitudinal fibers of an inner layer at right angles. Beneath this there is a fine granular layer, with a few longitudinal fibers. Some of the granules of this layer are distinctly nucleated. In sections of some of the segments there is a layer of longitudinal muscles in which the fibers are arranged in rather thick parallel fascicles. The interior of the immature segments is, in great part, filled with the oval or elliptical spermatic capsules, .03 to .06^{mm} in diameter, and containing granular cells, some of which are nucleated, from .025 to .005^{mm} in diameter.

Sections of ripe segments show the entire segment to be filled with ova, with the exception of a small space in the center, which is occupied by the remnant of the ovary, and one of the anterior corners into which the cirrus bulb is crowded. The ova are yellowish in color, with unstained granular contents, measuring about .014^{mm} in diameter, and for the most part with an extremely irregularly collapsed membranous shell. Some ova were found near the margin in which the shells were entire, and were then seen to be very thin and delicate and separated by a clear space from the granular interior. These measured from .028^{mm} to .038^{mm} in diameter, and the granular contents .022^{mm} in diameter.

The ova occur in these segments in enormous numbers. They fill the segment to its extreme outer margins. The division between the mass of ova of two adjacent segments was found to be reduced to a thin partition .008^{mm} thick. The marginal walls of the segments were reduced to about the same thickness.

Syndesmobothrium Diesing.

This genus is characterized by Diesing as follows: Body articulate tæniæform; neck tubular, rounded at the base; head tetragonal, with four terminal prominent bothria attached to head by posterior margin, cruciformly disposed, oval, slightly convex, joined with each other at the base by a membrane; proboscides four, filiform, armed, each one running through a bothrium (pedicel) excurrent at apex, long, retractile in the neck. Genital apertures marginal (?). In intestines of marine fishes of tropical America.

Syndesmobothrium filicolle, sp nov.

[Plate xv. Figs. 2–4.]

A single specimen belonging to the genus *Syndesmobothrium*, without mature segment, the neck attached to a linear oblong body (blastocyst) and with the proboscides retracted was found in the spiral valve of a sting ray (*Trygon centrura*) in August, 1884, at Wood's Holl, Massachusetts.

This description is necessarily so meager that I have hesitated to bestow a specific name on the specimen which furnishes the data for it.

The head is tetragonal transverse, cruciform. Bothria four, subcircular, convex, cup-shaped, each the termination of a short cylindrical pedicel. They are arranged in a cruciform manner, but also somewhat in pairs and capable of being directed either forward or backward in pairs. Proboscides very long and slender, each one running through a pedicel and emerging at the apex, apparently beside the bothrium proper. Neck very long and slender, cylindrical, enlarging slightly at the contractile bulbs and rounded at the base, tapering to a point, where it is connected with the body (blastocyst); proboscis-sheaths spiral, contractile bulbs linear oblong; hooklets long and slender, falcate; blastocyst linear oblong, a little longer than the head and neck.

Dimensions of alcoholic specimen, somewhat flattened: Length of head and neck, 4.60^{mm}; length of blastocyst, 5.25^{mm}; diameter, 0.76^{mm}; breadth of head, about 0.50^{mm}; diameter of bothrium, 0.12^{mm}; diameter of pedicel, 0.14^{mm}; diameter of neck, 0.14 to 0.30^{mm} at contractile bulbs; length of proboscides about 3^{mm}; length of contractile bulbs, 0.84^{mm}; breadth, 0.08^{mm}.

The proboscides were retracted but the hooks could be seen through the transparent neck. At the base of the proboscides they were about 0.032^{mm} in length; near the middle of the proboscides they were 0.06^{mm} long, with basal supports as much as 0.03^{mm} wide. The hooks appear to be of pretty uniform shape; being long, slender, recurved, falcate, with rather broad basal supports.

I have met with encysted forms similar to this in various species of the *Teleostei* such as *Pomatomus saltatrix*, *Cybium regale*, etc. One from the Spanish mackerel (*Cybium regale*) was described by me in the American Naturalist for February, 1887, under the name of a larval *Tetrarhynchobothrium*.

Family V.—TÆNIÆDÆ.

Tetracotyleidæ Diesing.

PARATÆNIA, gen. nov.

Body tæniæform, articulate. Head subglobose, with four small opposite, sessile bothria. Terminal os and sixteen protractile tentacular proboscides. Genital apertures marginal.

This form appears to be related to the genus *Tænia*. The tentacular proboscides are probably homologues of the proboscis of avian *Tæniædæ*.

43 *Paratænia medusia*,* sp. nov.

[Plate xv, Figs. 5–9.]

Head somewhat globose but variable according to state of contraction, wider than strobile. Bothria four, small, sometimes papilli-

* The reference of this species to the *Tæniædæ* is provisional. Certain structural peculiarities suggest the propriety of referring it to the *Tetrabothriidæ* near *Echeneibothrium*.

form. Circular os at apex of head from which sixteen soft tentacle-like proboscides may be protruded. Neck none. First segment short; succeeding segments often moniliform, then lengthened; last segments four or five times as long as broad, loosely attached to each other. Genital apertures marginal; cirrus echinate, ova numerous with thin membranous shell. Strobile small, so far as observed not exceeding 6^{mm}.

Habitat.—Trygon centrura, spiral valve, August 1, 3, and 10, 1887. Wood's Holl, Massachusetts.

During the month of July and August, 1887, I made careful and painstaking search for entozoa in the sting ray (*Trygon centrura*). On three different occasions, in the course of these examinations, I found a few small cestods in the spiral valve which I at first took to be fragments or immature forms of some of the various species of the *Tetrabothriidæ* which I found at the same time in most of these hosts. On one occasion, however, I examined a sting ray which yielded no entozoa except these small forms, a very minute *Rhynchobothrium* and a few cysts from the stomach wall. When these small cestods were examined, while they were yet alive, they showed no signs of activity in the sea-water in which they had been placed, and as the short chains of segments all exhibited a tendency to fall to pieces readily, the idea was naturally suggested that they were *Tetrabothriidæ* which had been introduced into the ray in a mature condition along with their proper host and had succeeded in resisting the action of the digestive fluids of the ray for a while, but were now succumbing to the influence of their uncongenial surroundings.

On account of the number of larger and more attractive new species that were collected at the same time, these very small and apparently unpromising forms were given but a superficial examination at first. I found, however, that they possessed four bothria or acetabula and a terminal opening at the apex of the head. It was only after the specimens had lain for some time in alcohol and I had leisure to study them carefully that their true nature was revealed. One is tempted, when doing systematic work on any group, to pronounce each new form that meets his eyes the most remarkable of all. I have become accustomed to having my first notions, with regard to these soft-bodied forms, rudely shaken by more careful subsequent study, but I think I have never encountered any forms of entozoa that have proved to be so different from first conceptions as these have done.

In the first place the worms are quite small. The longest living specimen that was measured was less than 5^{mm}. They must grow somewhat longer than this, however, as an alcoholic specimen has been found which measured 6^{mm}. The chains of joints that remain attached to the heads of alcoholic specimens are few of them as much as 2^{mm} in length. The head is of various shapes. When the tentacular probos-

cides are retracted it is usually globular, often truncated at the apex. Again it may be elongated glandiform or pyriform on account of a constriction behind the bothria.

The bothria, four in number, are opposite and of varied appearance. In some cases they are sessile and difficult to see, in others they are elevated on low papillæ. The latter usually stand at right angles to the axis of the body, although in cases where the proboscides are retracted, they are sometimes directed forward. In one case they were so arranged as to give to the head a decidedly cuboidal shape. In this case the diameter of the head was .36^{mm}, the outside diameter of a tubular bothrium was .08^{mm}, the inside diameter .04^{mm}. Seen from the front the bothria made the four corners of a square. The bothria are sometimes on the anterior part of the head, this of course only when the proboscides are retracted, sometimes about the middle.

The most remarkable changes take place in the head when the tentacular proboscides are protruded in whole or in part; these proboscides are sixteen in number; among the lot of thirty specimens, more or less, there were fortunately four or five which had the proboscides protruded, and of this number two at least in which they were fully protruded so as to form a terminal rosette-like cluster, made by the sixteen radiating tentacular-like proboscides. It is probable that these organs can be extended farther than was indicated in the alcoholic specimens. In one specimen the head was .5^{mm} in length, including the terminal rosette; diameter of head behind bothria, .16^{mm}; diameter of rosette, .34^{mm}; length of bothrial papilla about .06^{mm}; diameter of first segment .06^{mm}.

Only a few of the more frequent shapes which these scolices assume have been mentioned, but enough have been alluded to which, together with the sketches, should make future identifications reasonably certain. It is to be hoped that the polymorphous character of the head of this species may not be made the occasion of multiplying species unnecessarily.

An illustration is here afforded of the importance of preserving every specimen, and of not neglecting what may appear to be unimportant fragments. It is certainly possible to have obtained one-half of the specimens of this species that are in my collection without finding any that show the real structure of the head.

The proboscides are soft, tentacle-like, slender when fully extended; they are probably extended by evagination, although of this fact I am not yet certain; when all are fully extended they are found to be exactly sixteen in number, and form a terminal crown or rosette; in this condition they resemble the expanded tentacles of a sea-anemone. Sometimes only a few of these tentacles are protruded, and in one instance a single tentacle arose from the apex of the head and was surrounded closely by the four bothria; if found by itself it would have been a puzzle indeed and might have furnished the type of a new species. The longest tentacle that was observed measured .2^{mm} in length, and was

.02mm in diameter at base. When the tentacles are retracted, the head is terminated by a circular opening; the sheath or cavity in which the retracted tentacles lie sometimes extends to, and sometimes beyond, the bothria; at other times it is wholly in front of the bothria, in which cases the anterior part of the head is prolonged; in one case the length of the head was .34mm and the depth of the sheath .18mm.

The largest alcoholic specimen yielded the following measurements: Length, 6mm; length of head, .28mm; diameter of head, .23mm; diameter of first segment, .12mm; length of last segment, 1.8mm; breadth, .22mm. The length of the head in a living specimen was .48mm, length of strobile 4.8mm. In most of the specimens the first distinct segments begin immediately behind the head. In some, however, there is a slight obscuration of the first segments on account of differences of contraction. In the latter cases the first segments have the appearance of a short neck and are broader than in those cases where the first segments are distinct.

In the measurement of ten alcoholic specimens the maximum length of head was .5mm, minimum .22mm, average .314mm; maximum breadth .36mm, minimum .24mm, average .276mm. The average length of first segment in these specimens was .038mm, maximum .04mm, minimum .02mm, while in three of the specimens they were obscure. The average breadth of the first segment was .09mm, maximum .16mm, minimum .06mm.

Usually the first two or three segments are quite short and crowded together, while these are succeeded by a few rounded segments which impart to that part of the strobile a moniliform appearance. The succeeding segments increase in length rapidly, are distinctly separated from each other, and become detached easily. Very often there is a distinct constriction near the anterior end, with a corresponding swelling in the middle. The posterior mature segments are much elongated. In one specimen the last two proglottides, which are filled with ova, are together almost as long as the remainder of the strobile. The shape of the mature segments is quite characteristic. They are elongated, arcuate, of nearly uniform breadth throughout, except at a point near the anterior end, where they are narrowed by a neck-like constriction. They are rounded, blunt, and slightly swollen at each extremity. Ova fill the interior completely, with the exception of the cirrus and its bulb, the only part of the genitalia that persists in the mature segments, to within .28mm of the anterior end, where the uterine cavity stops abruptly, being limited by a transverse partition. The interior of the segment is, indeed, converted into a sac for containing ova. The anterior end of the mature segment in front of the transverse partition appears to be composed of the muscular walls alone. It probably retains some contractile power, and serves as a kind of locomotive organ for the free proglottis.

The ova consist of globular masses of granules or nuclei, surrounded by a thin transparent envelope, which is sometimes collapsed and irregu-

lar in outline. The diameter of the granular or nuclear masses ranges from .02 to .027mm, that of the entire ovum from .03 to .05mm. In one case, in a stained segment, there were observed among these granular masses with the transparent envelope a small cluster of amber-colored collapsed shells of ova about .036 and .022mm in the two diameters.

The cirrus was invaginated in every case, but could be plainly seen through the walls of the segment when the latter were rendered transparent in glycerine. The retracted cirrus is pyriform in shape, the inner end is the larger, directed anteriorly and a little toward one of the lateral sides. It is very thickly beset with fine bristles. It measured .094mm in length, and .05mm in diameter, narrowing to .02mm near the external aperture. The external opening of the cirrus is near the margin, about the middle of the segment. In the posterior mature segments, which were apparently slightly distorted, the genital aperture was situated from the margin a distance equal to one-fourth the breadth of the segments.

The ovaries are elongated, glandular, paired organs lying near the posterior end of the segment, one on each side of the median line. The vagina appears to open beside the cirrus on its posterior side. This fact, however, requires further verification. In segments which precede the mature ova bearing segments the retracted cirrus was seen to lie nearly transverse to the axis, inclined a little forward at the inner end, and equal in length to about three-fifths of the segments.

The testes are represented by a few globular or oval bodies lying along the middle line from the front end of the ovaries to the anterior end of the segment. These range in diameter from .055mm in some specimens to over .08mm in others. One of the largest of these oval testicles measured .086 and .047mm in its two diameters. In those segments in which the testes are best developed the ovaries are scarcely at all developed. Furthermore, the transition from segments with large testicles and incipient ovaries, to those in which the interior is completely filled with ova, is quite abrupt.

The exceeding smallness of this anomalous worm has doubtless caused it to be overlooked heretofore, while the extreme variability of the head might easily lead collectors to regard it as simply fragmental remains of other and larger cestods with which the sting ray abounds.

List of the Entozoa described in this paper, and their hosts.

No.	Entozoa.	Host.	Page.	Plate.	Figures.
1	*Dibothrium restiforme* sp. nov	*Tylosurus caribbæus*		I	1–16
2	*Dibothrium manubriforme* Lt	*Tetrapturus albidus. Histiophorus gladius.*			
3	*Dibothrium punctatum* Rud	*Limanda ferruginea. Lophopsetta maculata.*		II	1–4
4	*Dibothrium microcephalum* Rud	*Mola rotunda*		II	5–18
5	*Dibothrium plicatum* Rud	*Xiphias gladius*		III	1–6
6	*Dibothrium rugosum* Rud	*Gadus morrhua*		III	7–10
7	*Anthobothrium laciniatum* sp. nov	*Carcharias obscurus*		III IV	10–13 1–3
8	*Anthobothrium pulvinatum* sp. nov	*Trygon centrura*		IV V	4–9 1–2
9	*Echeneibothrium variabile* sp. nov	*Raia erinacea*			
10	*Rhinebothrium flexile* gen. et sp. nov	*Trygon centrura*		V	3–5
11	*Rhinebothrium cancellatum* gen. et sp. nov.	*Rhinoptera quadriloba*		V	6–8
12	*Rhinebothrium longicolle* gen. et sp. nov	*Myliobatis freminvillei*		VI	1–4
13	*Spongiobothrium variabile* Lt	*Trygon centrura*			
14	*Discocephalum pileatum* gen. et sp. nov	*Carcharias obscurus*		X	1–7
15	*Phyllobothrium foliatum* sp. nov	*Trygon centrura*		VI	5–10
16	*Anthocephalum gracile* gen. et sp. nov	*Trygon centrura*		VII	1–2
17	*Orygmatobothrium angustum* Lt	*Carcharias obscurus*		VII	3
18	*Crossobothrium laciniatum* Lt	*Odontaspis littoralis*		VII	4
19	*Lecanicephalum peltatum* gen. et sp. nov	*Trygon centrura*		IX	2–4
20	*Tylocephalum pingue* gen. et sp. nov	*Rhinoptera quadriloba*		IX	5–9
21	*Calliobothrium verticillatum* Rud	*Mustelus canis*			
22	*Calliobothrium eschrichtii* Van Ben	*Mustelus canis*		VII	5–12
23	*Acanthobothrium paulum* sp. nov	*Trygon centrura*		VIII	1–7
24	*Phoreiobothrium lasium* Lt	*Carcharias obscurus*			
25	*Platybothrium cervinum* gen. et sp. nov	*Carcharias obscurus*		VIII IX	8–10 1
26	*Thysanocephalum crispum* Lt	*Galeocerdo tigrinus*		X	8–9
27	*Rhynchobothrium bulbifer* Lt	*Mustelus canis*		XI	1–2
28	*Rhynchobothrium tumidulum* sp. nov	*Mustelus canis*		XI	3–11
29	*Rhynchobothrium hispidum* sp. nov	*Trygon centrura*		XI	12–17
30	*Rhynchobothrium longispine* sp. nov	*Trygon centrura*		XI	18–20
31	*Rhynchobothrium tenuispine* sp. nov	*Trygon centrura*		XII	1–2
32	*Rhynchobothrium heterospine* sp. nov	*Mustelus canis*		XII	3–6
33	*Rhynchobothrium imparispine* sp. nov	*Raia erinacea*		XII	7–9
34	*Rhynchobothrium wagneri* sp. nov	*Trygon centrura*		XII	10–12
35	*Rhynchobothrium lomentaceum* Dies	*Mustelus canis*		XIII	1–3
36	*Rhynchobothrium longicorne* sp. nov	*Odontaspis littoralis*		XIII	4–8
37	*Otobothrium crenacolle* gen. et sp. nov	*Sphyrna zygæna*		XIII XIV	9–15 1–4
38	*Tetrarhynchus tenue* sp. nov	*Trygon centrura*		XIV	5–6
39	*Tetrarhynchus robustum* sp. nov	*Trygon centrura*		XIV	7–9
40	*Tetrarhynchus bisuleatum* Lt	*Carcharias obscurus*		XIV XV	10–12 1
41	*Syndesmobothrium filicolle* sp. nov	*Trygon centrura*		XV	2–4
42	*Paratænia medusia* gen. et sp. nov	*Trygon centrura*		XV	5–9

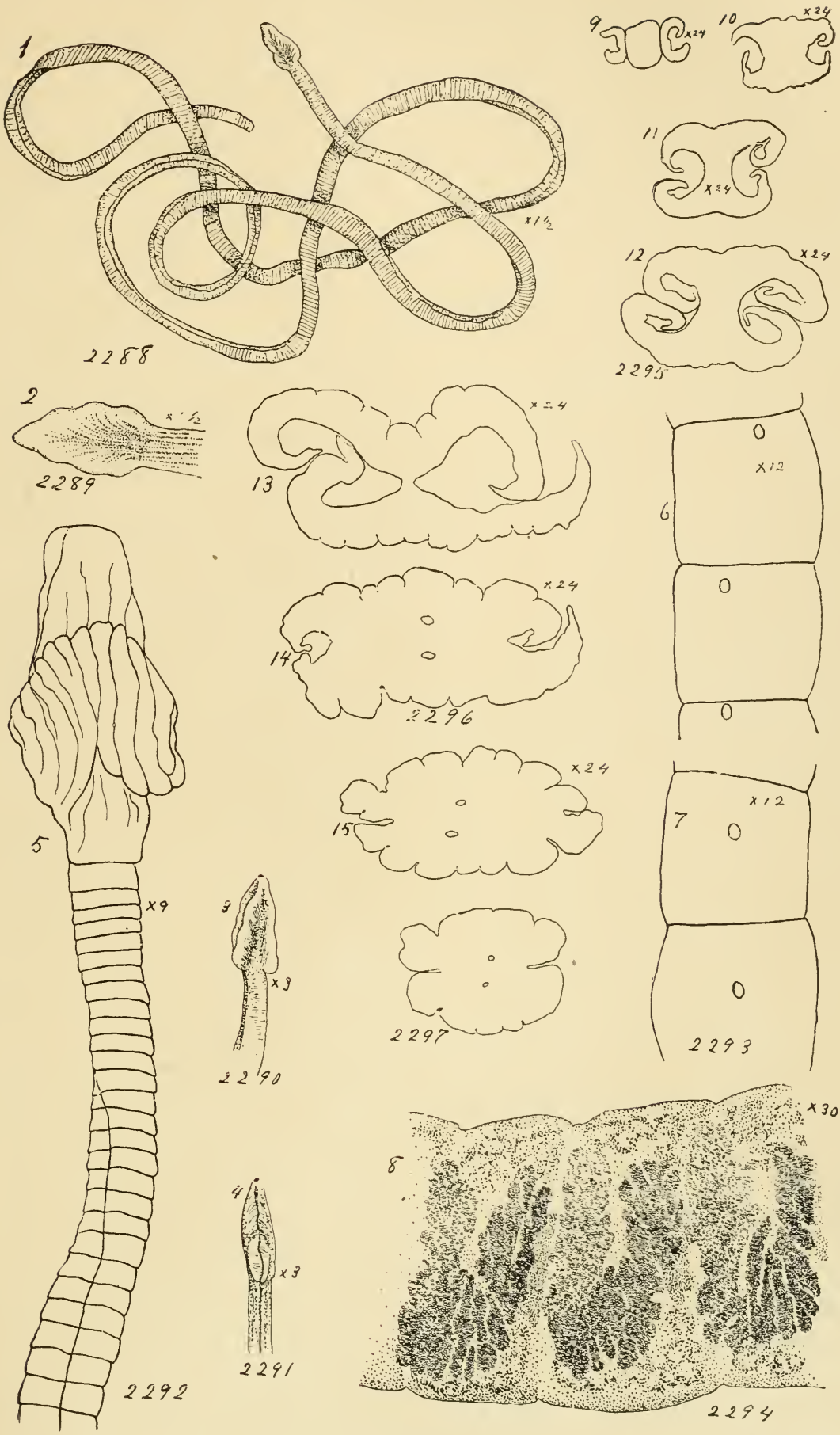
WASHINGTON AND JEFFERSON COLLEGE,
Washington, Pa., October 6, 1888.

PLATE I.

Dibothrium restiforme, sp. nov.

FIG. 1. Adult strobile, from life, × 1½.
FIG. 2. Lateral view of head, from life, × 4½.
FIG. 3. Another view of head, from life, × 3.
FIG. 4. Marginal view of head, showing continuation of fossa into beginning of lateral groove, from life, × 3.
FIG. 5. Head and anterior part of body, from alcoholic specimen, × 9.
FIG. 6. Outline of mature segments, showing position of uterine aperture, × 12.
FIG. 7. Outline of same, showing opposite side of strobile with genital aperture, × 12.
FIG. 8. Posterior segments with ova, from alcoholic specimen, × 30.
FIG. 9–16. Outline of transverse sections of head, each magnified about 24 diameters. Fig. 9, section near apex; Figs. 10–12, sections between apex and middle; Fig. 13, about middle of head; Figs. 14 and 15, between middle and base; Fig. 16, at base of head behind fossæ. The lateral grooves appear at the margins of the sections.

All figures made by Margaret B. Linton.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2293
5
x9
3
x3
2290
4
x3
2291
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8
x30
2294

PLATE II.

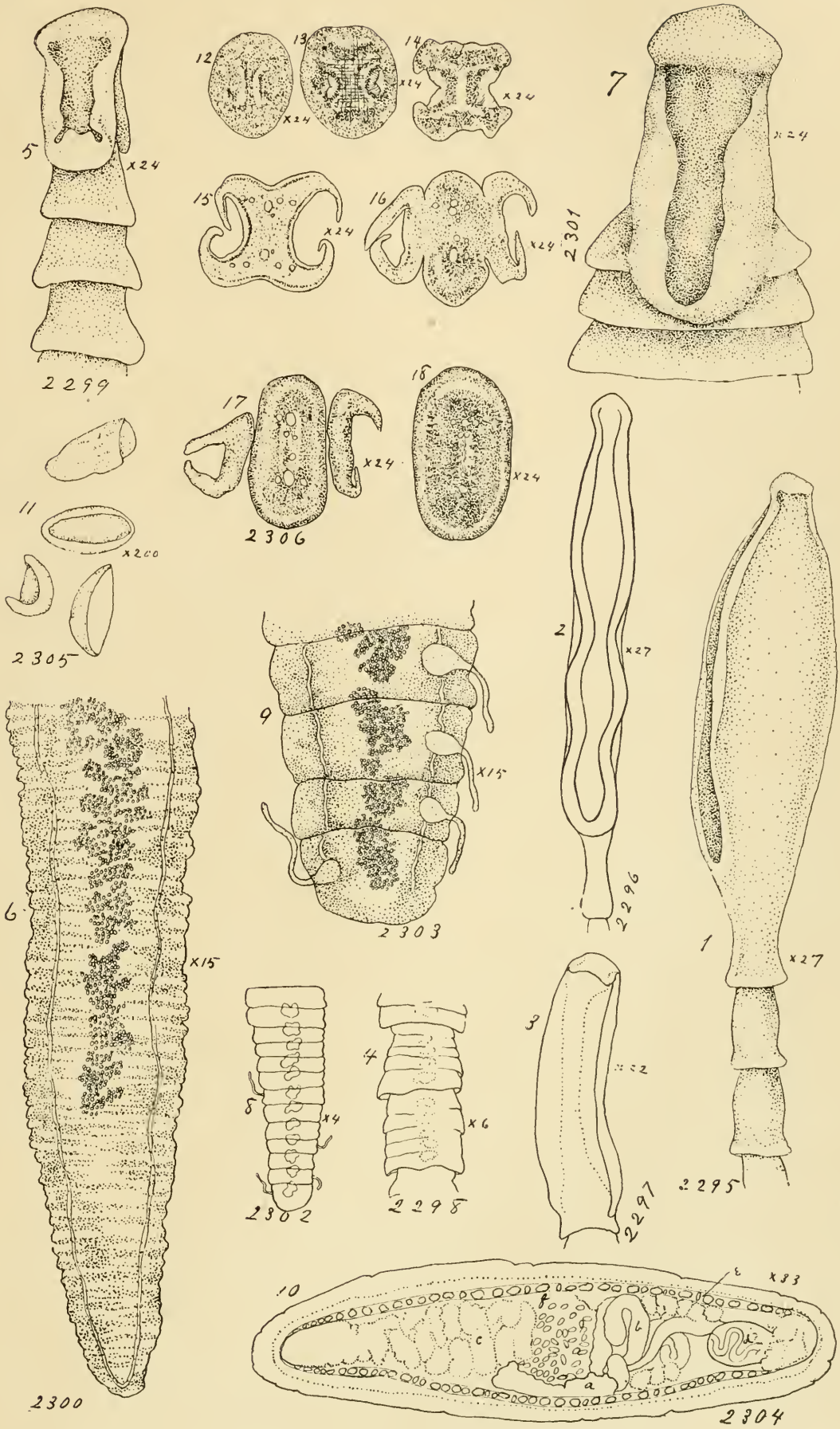
Dibothrium punctatum Rud.

FIG. 1. Lateral view of head and first segments, from life, × 27.
FIG. 2. Marginal view of same, from life, × 27.
FIG. 3. Lateral view of head, alcoholic specimen made transparent in oil of cloves × 22.
FIG. 4. Posterior part of strobile, showing characteristic grouping of segments, × 6.

Dibothrium microcephalum Rud.

FIG. 5. *Var. a*, marginal view of head and first segments, from alcoholic specimen, × 24.
FIG. 6. Posterior end of strobile of same. × 15.
FIG. 7. *Var. β*. Marginal view of head and first segments, from alcoholic specimen, × 24.
FIG. 8. Outline of posterior segments of same, × 4.
FIG. 9. The same enlarged, showing ova, × 15.
FIG. 10. Transverse sections near middle of body; *a*, ovary; *b*, vas deferens; *c*, testes; *d*, cirrus bulb and cirrus; *e*, layer of longitudinal muscle fascicles; *f*, ova, × 33.
FIG. 11. Collapsed ova, × about 200.
FIG. 12–18. Transverse sections of head, × 24; Fig. 12, near apex, showing cut ends of longitudinal muscles with a few transverse muscles; the beginnings of fossæ are indicated by crescent-shaped clear spaces with their convexities turned toward each other; Fig. 13, transverse muscles more numerous, crossing each other at right angles, anterior ends of lateral fossæ clearly outlined; Fig. 14, sections near anterior end of head, behind apical cushion; Fig. 15, section near middle of head; Fig. 16, section towards base of bothria; Fig. 17, section near base of head, bothria no longer united with head; Fig. 18, section through first segment; an outer concentric ring is beginning to separate from the inner core to form the posterior salient border of the segment.

All figures made by Margaret B. Linton.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2296
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x27
2295
6
x15
2300
8
x4
2302
4
x6
2298
3
x27
2297
10
x83
2304

PLATE III.

Dibothrium plicatum Rud.

FIG. 1. Mature strobile after lying for a short time in sea water, from life, × 1½.
FIG. 2. Young specimen found wholly inclosed in a cyst-like cavity of the rectinal wall, from life, × 4.
FIG. 3. Lateral view of head of same, × 4.
FIG. 4. Posterior segments of adult strobile, from alcoholic specimen, × 10. The sketch was made from a segment made transparent in oil of cloves, *a*, cirrus and cirrus bulb. The relatively large ova are plainly seen through the transparent walls of the segment.
FIG. 5. Ovum, alcoholic, × about 200.
FIG. 6. Longitudinal section through the postero-median part of the strobile; *a*, *a*, cirrus bulbs in marginal prolongations; *b*, longitudinal muscles; *c*, ova; *d*, granular masses, presumably testes, × 15.

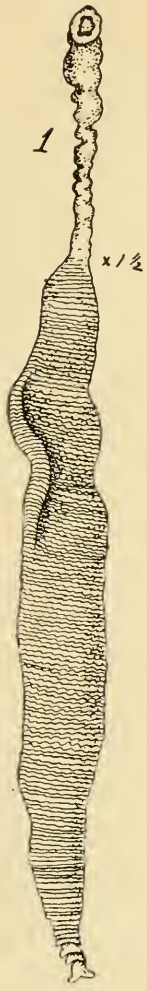
Dibothrium rugosum Rud.

FIG. 7. Longitudinal section through ripe segments; *a*, fascicles of longitudinal muscles; *b*, *b*, partitions separating adjacent segments; *c*, ova filling the interior of the segments; *d*, shred of connective tissue; other similar shreds are shown lying among the ova, × 21.
FIG. 8. Transverse section of a ripe segment; *a*, lateral aperture; *b*, *b*, layer of fascicled longitudinal muscles; *c*, shred of connective tissue extending into the interior of the segment which is filled with ova.
FIG. 9. Transverse section of antero-median segment, near the point where the ova first appears; *a*, position of cirrus and its bulb; *b*, vas deferens; *c*, *c*, layer of fascicled longitudinal muscles.
FIG. 10. Ova, alcoholic, × 200.

Anthobothrium laciniatum, sp. nov.

FIG. 11. Var. *filicolle*, head and neck from life, × 34.
FIG. 12. Var. *brevicolle*, head and neck from life, × 38.
FIG. 13. Var. *filicolle*, front view of head, compressed, from life, × 42.

All the figures made by Margaret B. Linton.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x 1½
2307


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x 4


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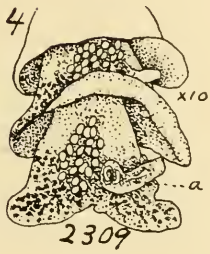
x 4
2308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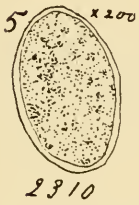
2309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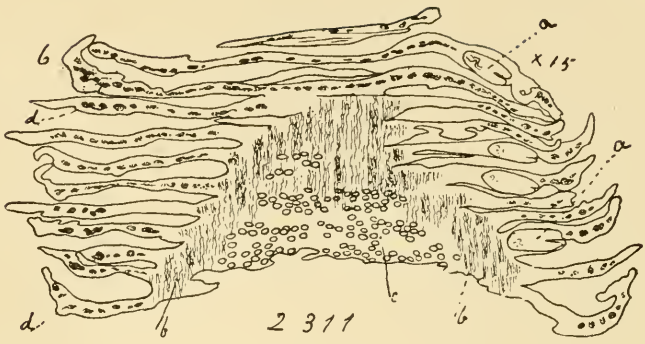
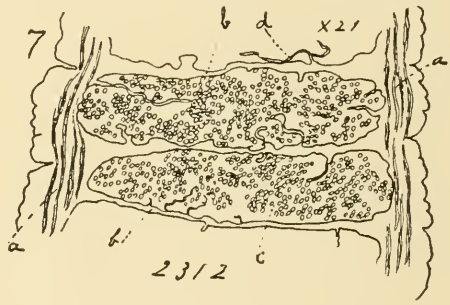
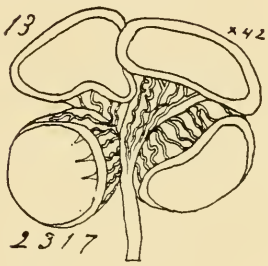
x 200
2310


6
a
x 15
d
a
c
d
b
b
2311


7
b
d
x 21
a
a
b
c
2312


10
x 200


8
a
x 21
b
c
b
2313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x 42
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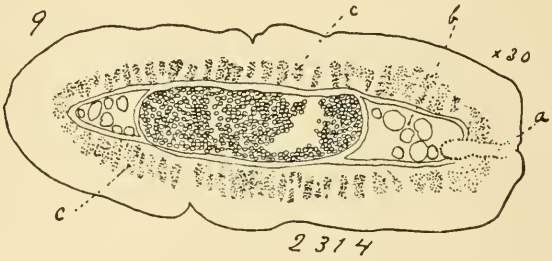
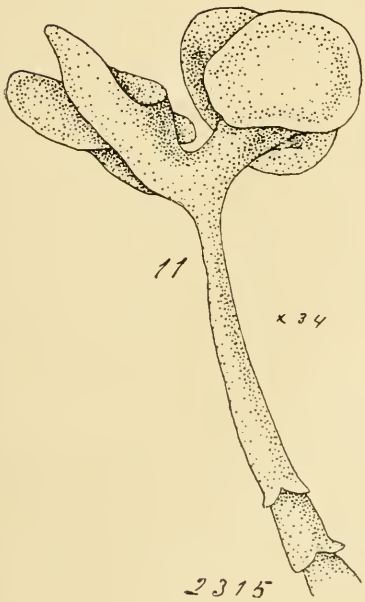

9
c
b
x 30
a
c
2314


11
x 34
2315

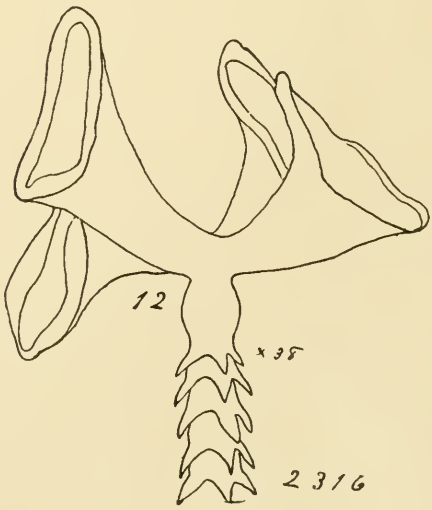

12
x 35
2316

PLATE IV.

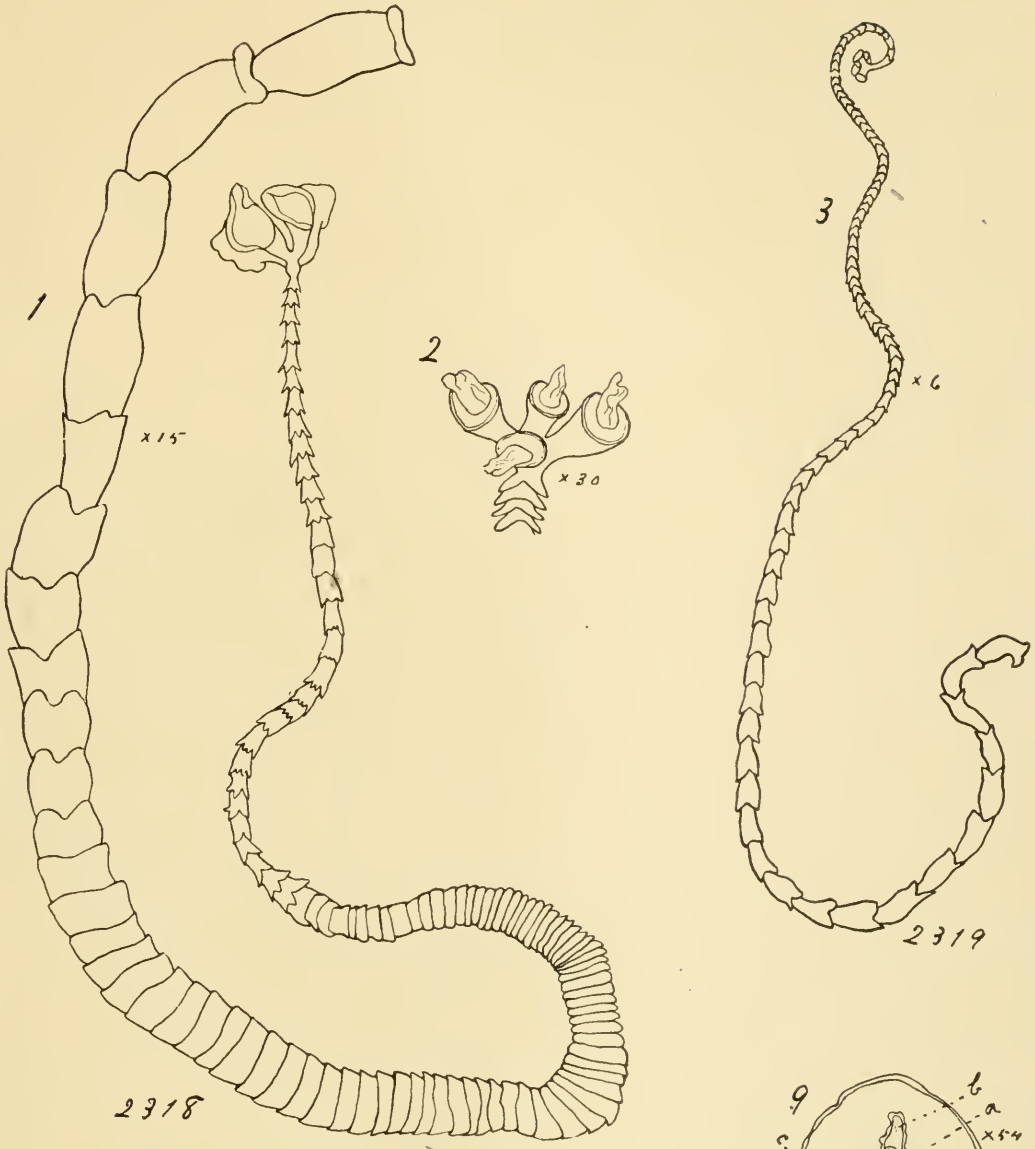
Anthobothrium laciniatum, sp. nov.

FIG. 1. Var. *brevicolle*. Outline of strobile, from life, × 15.
FIG. 2. Head of an alcoholic specimen with the thin faces of the bothria protruding. × 30.
FIG. 3. Outline of strobile, from life, an occasional form, × 6.

Anthobothrium pulvinatum sp. nov.

FIG. 4. Head and part of neck, lateral view, from life, × 8.
FIG. 4a. Part of face of bothrium of alcoholic specimen.
FIG. 5. View of head from behind, showing pedicels and cushion-like bothria, from life, × 4.
FIG. 6. Outline of posterior segments, from life, × 3.
FIG. 7. Spines of cirrus, from life, × about 750.
FIG. 8. Transverse section at base of head; *a*, thick layer, composed for the most part of longitudinal muscles, not shown in sketch; *b*, layer of circular fibers; *c*, *c*, the two pairs of aquiferous vessels, × 54.
FIG. 9. Transverse section a short distance back of head; *a*, *a*, aquiferous vessels; *b*, *b*, lateral nerves; *c*, *c*, part of connective tissue fibers seen in the section.

Figure 2 by the author, all others by Margaret B. Linton.


1
x 15
2318
2
x 30
3
x 6
2319

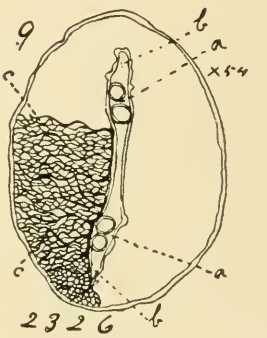

4a
2321


4
x 5
2320


6
x 3
2322


5
x 4
2323


7
x 710
2324


9
b
a
x 54
c
c
a
b
2326


8
a
b
c
x 54
c
2325

PLATE V.

Anthobothrium pulvinatum, gen. et sp. nov.

FIG. 1. Diagrammatic sketch of transverse section of head and pedicels of bothria; *a*, central nervous mass; *b b*, nerve masses of pedicels; *c*, *c*, commissures connecting central mass with masses of pedicels; *d*. *d*, nerves from nerve masses of pedicel to bothria; *e*, transverse muscles. Only a small part of the musculature is shown; *f f*, aquiferous vessels, × 40.

FIG. 2. Anatomy of mature segment as revealed in longitudinal section; *a*, vas deferens; *b b*, ovaries; *c*, shell gland; *d*, vagina; *e*, longitudinal muscles; *f*, cirrus, × 14.

Rhinebothrium flexile, gen. et sp. nov.

FIG. 3. Strobile, outline from life, details of last two segments filled in from alcoholic specimen, × 22.

FIG. 4. Head and neck of same, from life, × 45.

FIG. 5. Disposition of aquiferous vessels in neck and bases of pedicels, from life, compressed and greatly enlarged.

Rhinebothrium cancellatum, sp. nov.

FIG. 6. Head and neck, from life, × 36.

FIG. 7. Diagram of bothrium showing arrangement of loculi, × 45.

FIG. 8. Side view of single bothrium and its pedicel, outline from life, × 36.

Fig. 1, by the author, all others by Margaret B. Linton.

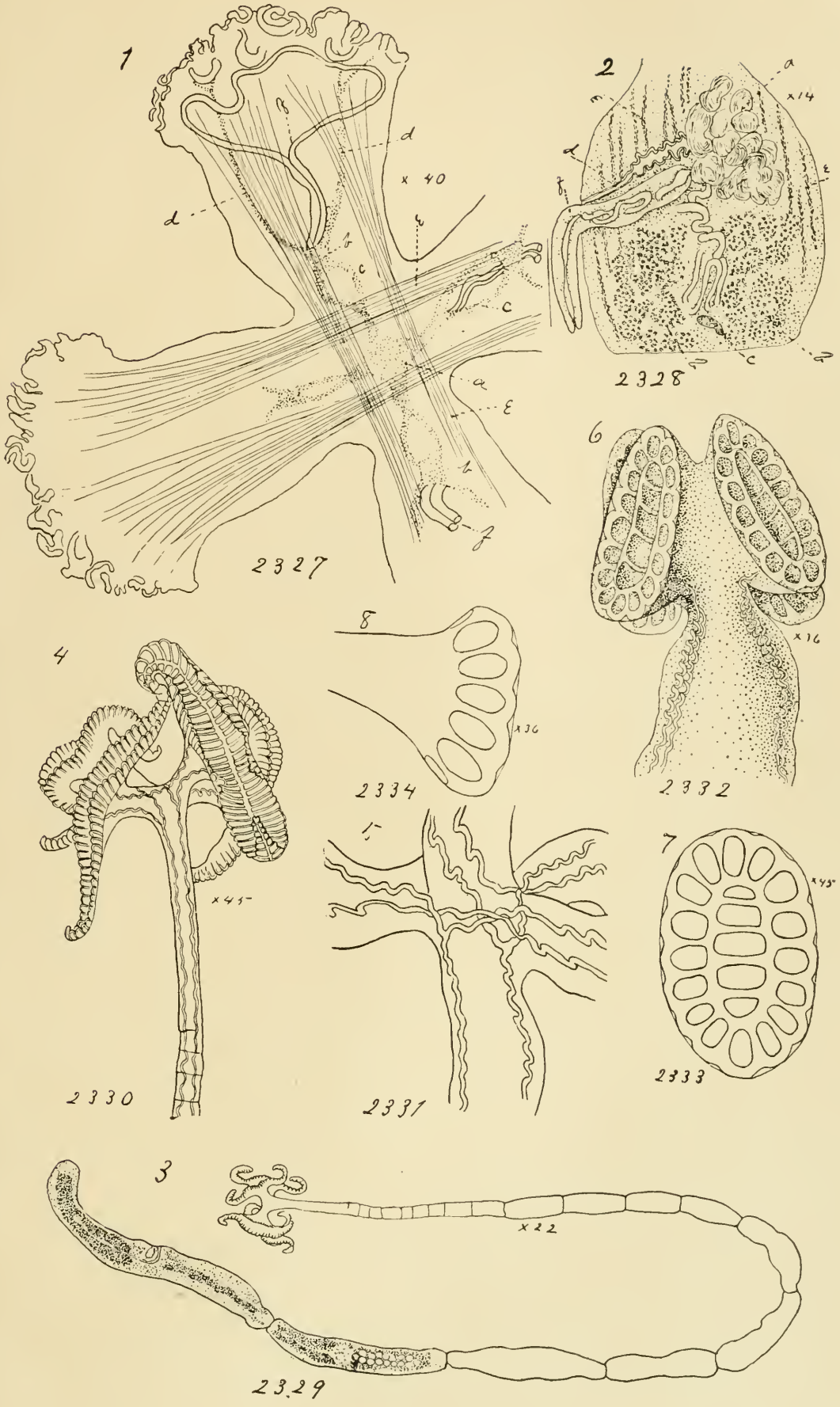

1
x 40
2327
2
x 14
2328
6
x 16
2332
8
x 30
2334
4
x 45
2330
5
2331
7
x 45
2333
3
x 22
2329

PLATE VI.

Rhinebothrium longicolle, sp. nov.

FIG. 1. Strobile, from life, × 18.
FIG. 2. Head and neck of same, × 36.
FIG. 3. Diagram of bothrium showing plan of loculi, × 56.
FIG. 4. Side view of bothrium with its pedicel, from life, × 30.

Phyllobothrium foliatum, sp. nov.

FIG. 5. Head and neck, lateral view, from life, × 22. In this sketch the aquiferous vessels in the neck and bothria, the spiral fascicles of muscles in the neck and pedicels and the reticulated faces of the bothria are shown.
FIG. 6. Strobile, outline from life, × 3.
FIG. 7. Marginal view of head and neck, outline from life, × 12.
FIG. 8. Posterior segments, from life, × 12.
FIG. 9. Strobile, from alcoholic specimen, usual form.
FIG. 10. Strobile with attenuated neck, from alcoholic specimen.

All the figures made by Margaret B. Linton.

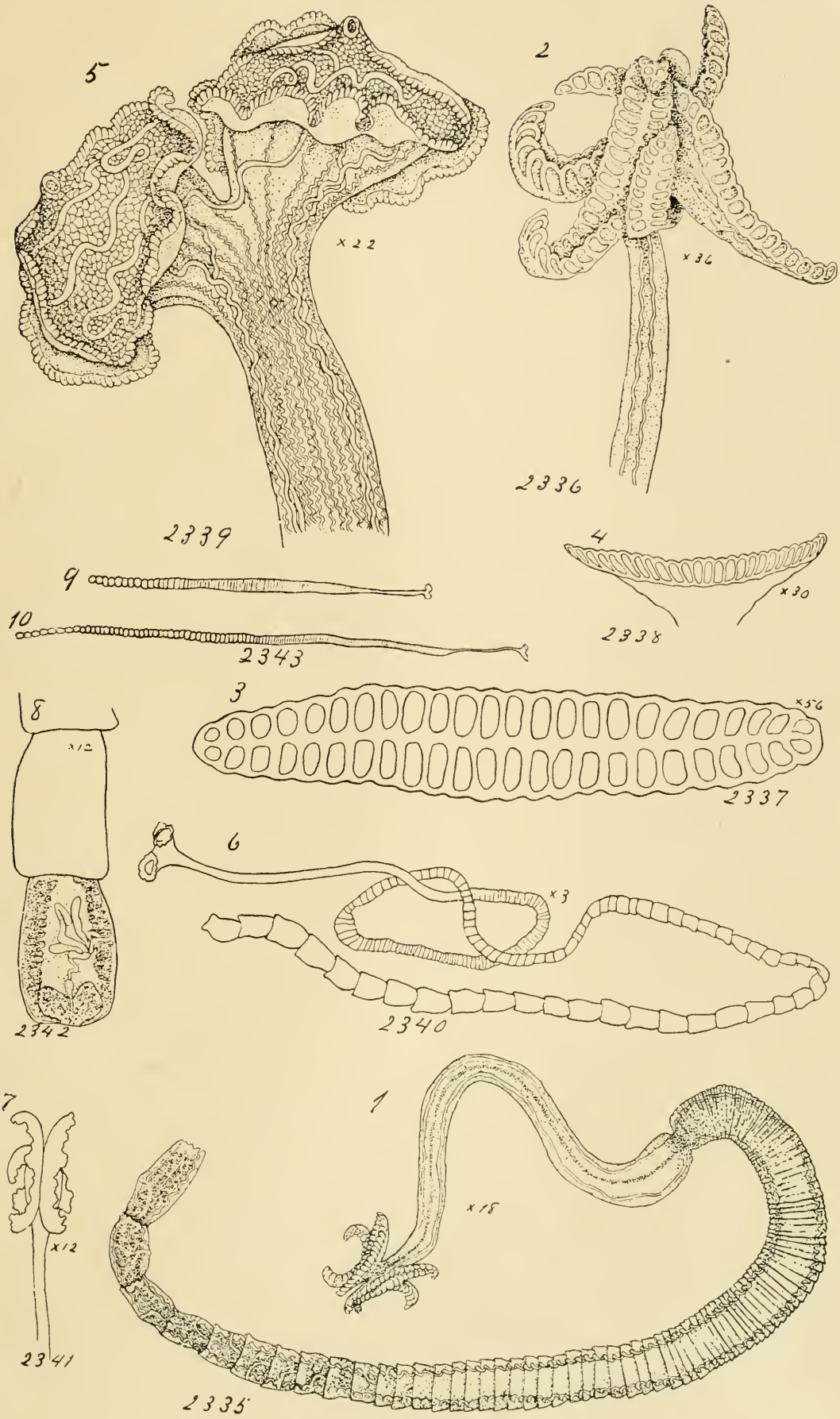

5
x 22
2339
2
x 36
2336
4
x 30
2338
9
10
2343
8
x 12
2342
3
x 56
2337
6
x 3
2340
7
x 12
2341
1
x 18
2335

PLATE VII.

Anthobothrium gracile, gen. et sp. nov.

FIG. 1. Head and neck of living specimen, × about 50.
FIG. 2. Head and neck of same individual in alcohol, × about 50.

Orygmatobothrium angustum Lt.

FIG. 3. Outline of head and neck, from life, × 21.

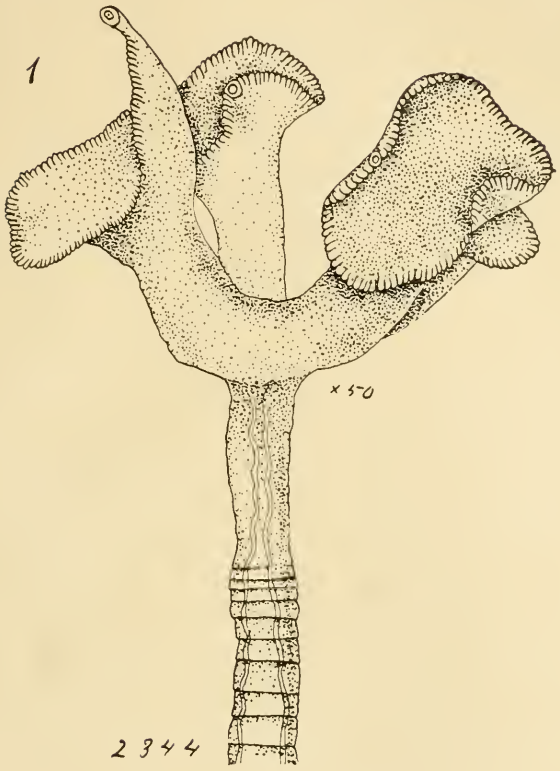
Crossobothrium laciniatum Lt., var. *longicolle.*

FIG. 4. Outline of strobile, from life, × 8.

Calliobothrium eschrichtii Van Ben.

FIG. 5. Head of living specimen, × 20.
FIG. 6. Bothrium with edges appressed, from life, × 20.
FIG. 7. Posterior segment, from life, × 30.
FIG. 8. Ovum undergoing segmentation, from life, × about 115.
FIG. 9. Another ovum, with granular stellate interior, also undergoing segmentation, from life.
FIG. 10. Outline of mature segment with ova issuing from the margin, from life.
FIG. 11. Outline of strobile, from alcoholic specimen, × 12.
FIG. 12. Hooks of a single bothrium, with part of the musculature, × 200.

All the figures made by Margaret B. Linton.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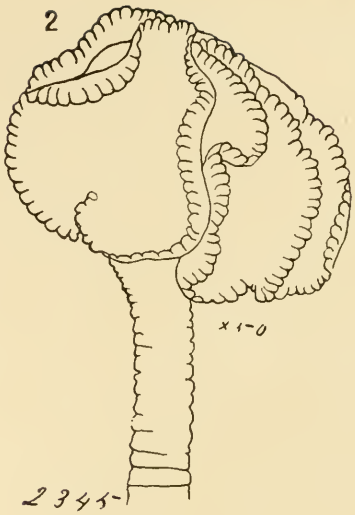
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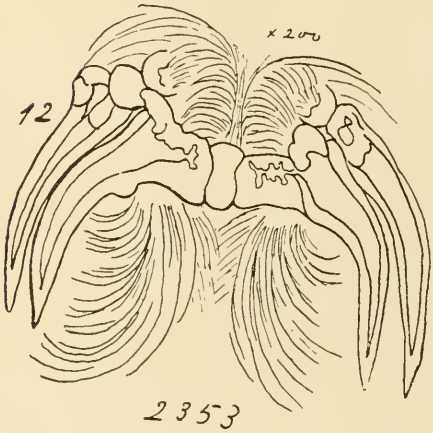
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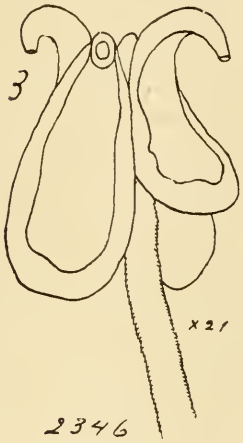
x 20
2353


4
x 8
2347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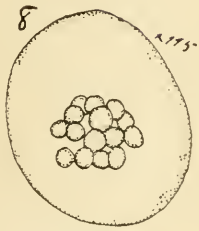
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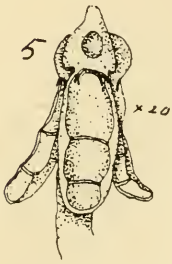
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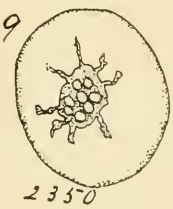
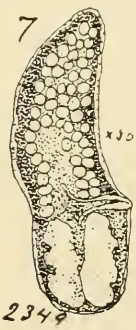

9


6
x 20
2348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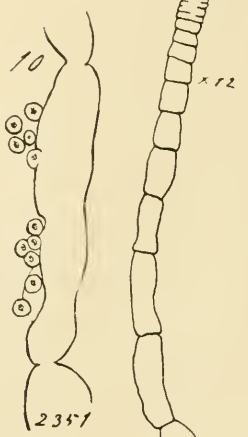
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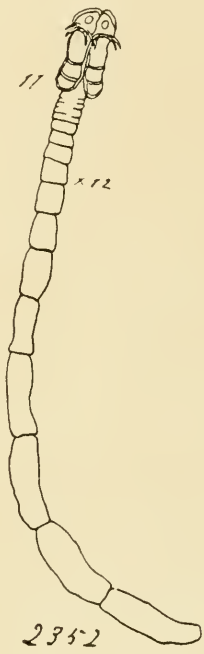

11
x 12
2352

PLATE VIII.

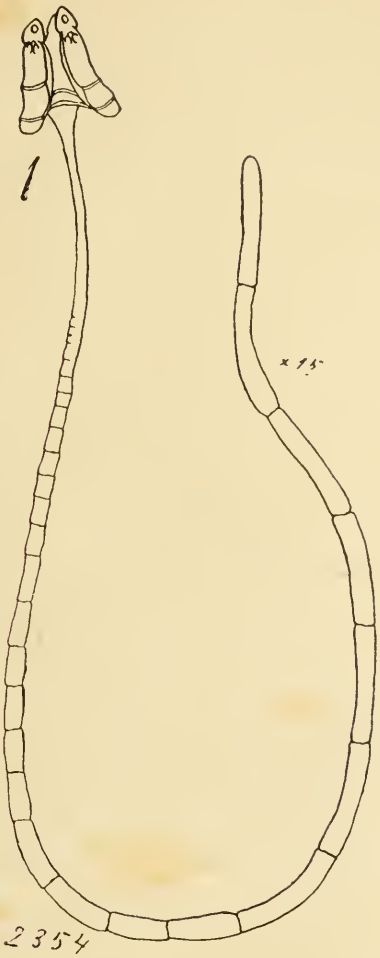
Acanthobothrium paulum, sp. nov.

FIG. 1. Outline of strobile, from life, × 15.
FIG. 2. Head of same at rest, × 24.
FIG. 3. Same with one pair of bothria thrust forward, × 97.
FIG. 4. Head of alcoholic specimen, × 40.
FIG. 5. Hooks of a single bothrium with a part of the musculature, × about 200.
FIG. 6. Posterior segment with everted cirrus, from alcoholic specimen, × 27.
FIG. 7. Cirrus, × about 200.

Platybothrium cervinum, gen. et sp. nov.

FIG. 8. Head and neck of living specimen after it had lain in sea-water an hour or more. The head was very flat and thin, and semi-transparent, × 58.
FIG. 9. Posterior segments, in glycerine, × 40.
FIG. 10. Set of hooks belonging to a single bothrium, × about 200.

All the figures made by Margaret B. Linton.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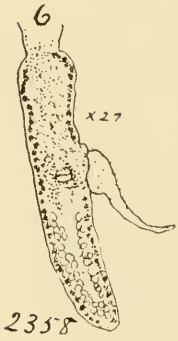
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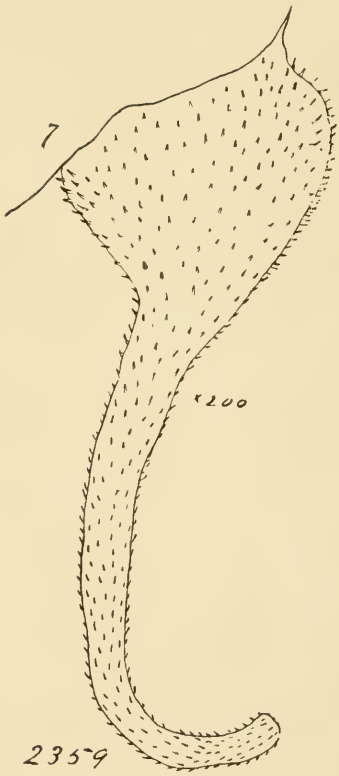
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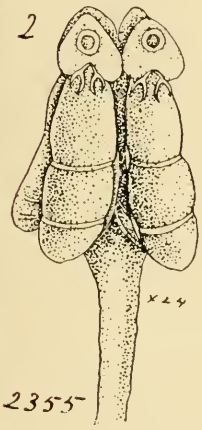
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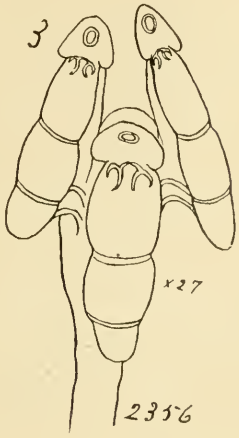
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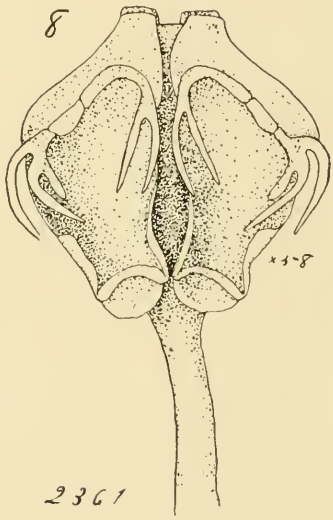
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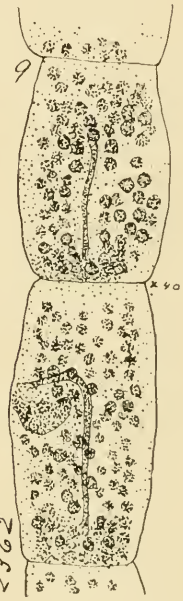
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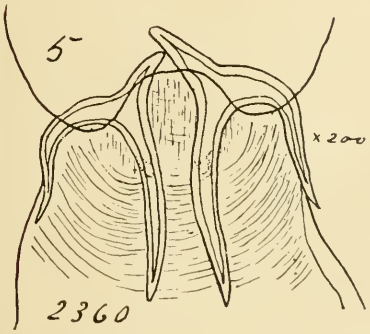
x 40
2362


5
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2360

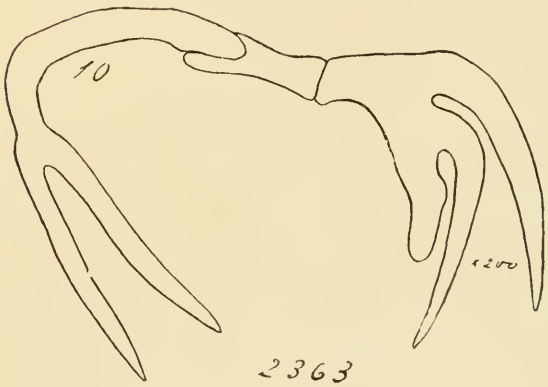

10
x 200
2363

PLATE IX.

Platybothrium cervinum, gen. et sp. nov.

FIG. 1. Outline of living strobile, × 12.

Lecanicephalum peltatum, gen. et sp. nov.

FIG. 2. Outline of living strobile, × 27.
FIG. 3. Top view of head of same, × 27.
FIG. 4. Posterior segments of same, compressed, × 27.

Tylocephalum pingue, gen. et sp. nov.

FIG. 5. Outline of living specimen, × 3.
FIG. 6. Head and neck of living specimen, × 18.
FIG. 7. Outline of posterior segments, × 24.
FIG. 8. Head and neck of same individual, when made transparent in oil of cloves, × 24.
FIG. 9. Outline of same, showing posterior part of head at its junction with the neck, × 24.

All the figures made by Margaret B. Linton.

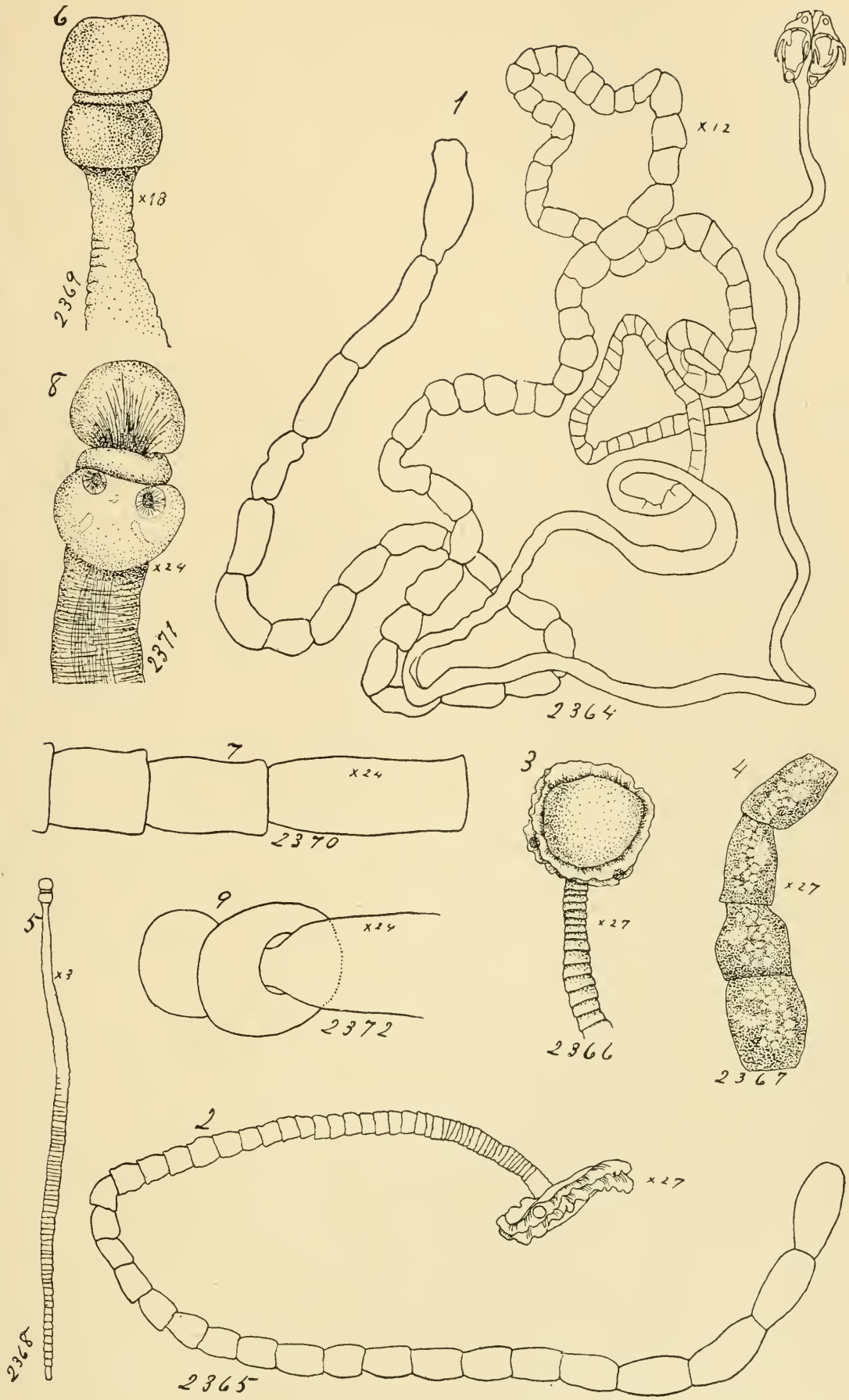

6
×18
2369
8
×24
2371
1
×12
2364
7
×24
2370
3
×27
2366
4
×27
2367
5
×3
2368
9
×24
2372
2
×27
2365

PLATE X.

Discocephalum pileatum, gen. et sp. nov.

FIG. 1. Var. α. Head and neck, from life, $\times$ 9.
FIG. 2. Var. β. Head and neck of living specimen, $\times$ 9.
FIG. 3. Another view of the same, $\times$ 9.
FIG. 4. Outline of median segments, from life, $\times$ 6.
FIG. 5. Outline of posterior segments, from life, var. α, $\times$ 6.
FIG. 6. Outline of section through head, $\times$ 38.
FIG. 7. Section of mature segment, $\times$ about 8; *a*, *a*, ovaries; *b*, *b*, uterine cavities with clusters of ova; *b'*, *b'*, uterine cavities without ova; *c*, vagina; *d*, base of invaginated cirrus; *e*, *e*, convolutions of the vas deferens; *f*, *f*, testes.

Rhynchobothrium bulbifer Lt.

FIG. 8. Free proglottis, from life, $\times$ 15; *a*, bulb of cirrus partly protruding from margin of segment; *b*, vagina, near its exterior opening; *c*, enlargement of vagina into a receptaculum seminis; *d*, *d*, vessels of the water-vascular system; *e*, *e*, spermatic capsules of testes; *f*, cirrus bulb with vas deferens entering the anterior part of the inner extremity; *g*, *g*, ova: *h*, posterior coils of vas deferens.
FIG. 9. Cirrus of same everted with escaping spermatozoa, from life.
All figures made by Margaret B. Linton.

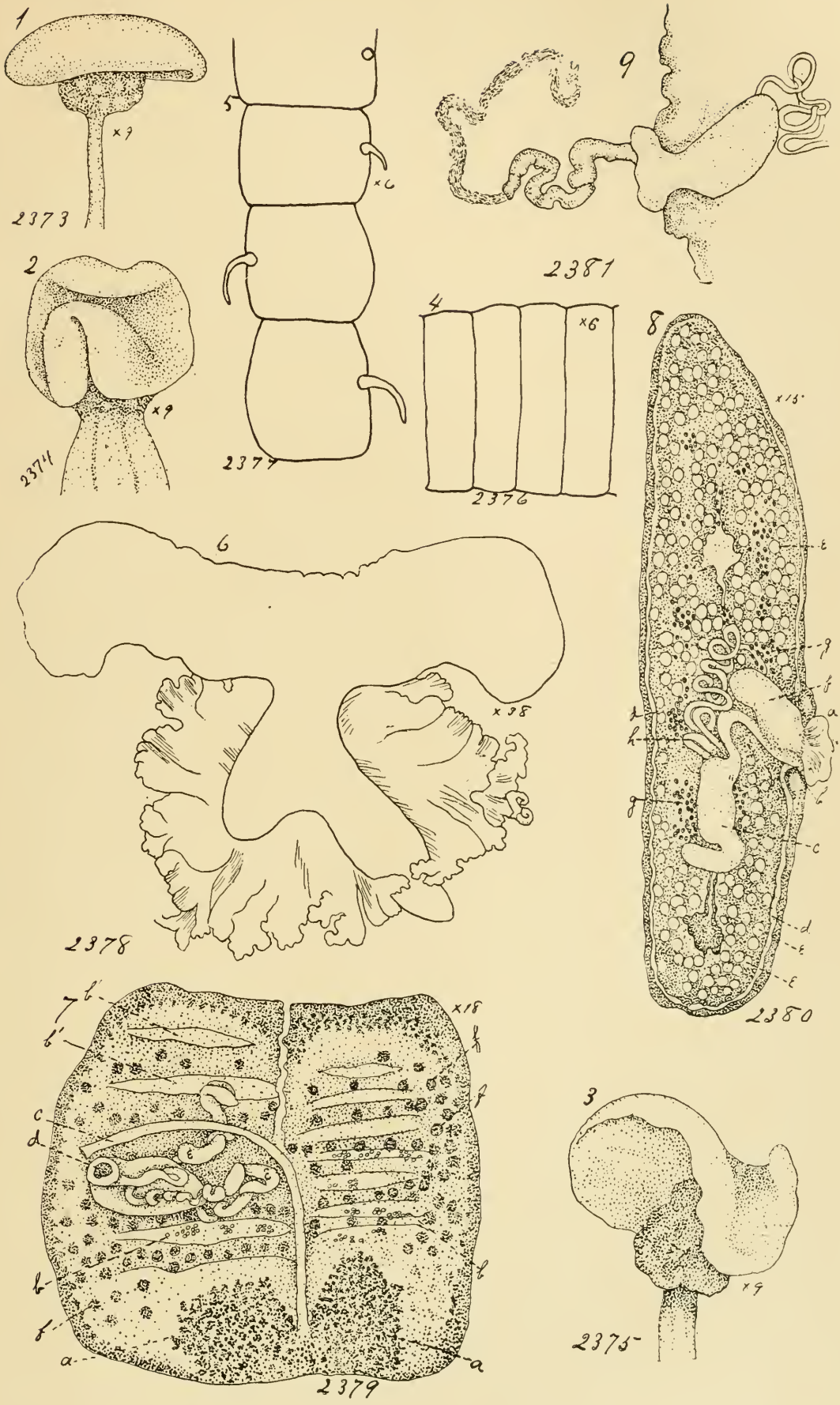

1
×9
2373
5
×6
2377
9
2381
2
×9
2374
4
×6
2376
8
×15
2380
6
×38
2378
7
×18
2379
3
×9
2375

PLATE XI.

Rhynchobothrium bulbifer Lt.

FIG. 1. One view of proboscis, from young specimen, × about 400.
FIG. 2. Principal forms of larger hooklets, × about 400.

NOTE.—For additional figures of this species see U. S. Fish Commission Report for 1886, p. 508, Plate v. Figs. 17 and 18, under *R. tenuicolle*.

Rhynchobothrium tumidulum, sp. nov.

FIG. 3. Strobile, from life, × 15.
FIG. 4. Lateral view of head of same, bothria directed forward, from life.
FIG. 5. Top of head of same, from life; the bothria are not usually so strongly emarginate in alcoholic specimens.
FIG. 6. Lateral view of head at rest; from life.
FIG. 7. Proboscis, at base, × about 400.
FIG. 8. One view of proboscis about the middle, × about 400.
FIG. 9. Another view of proboscis near the middle, × about 400.
FIG. 10. Embryo(?), from life, × about 200.
FIG. 11. Embryo(?), from alcoholic specimen, × about 200.

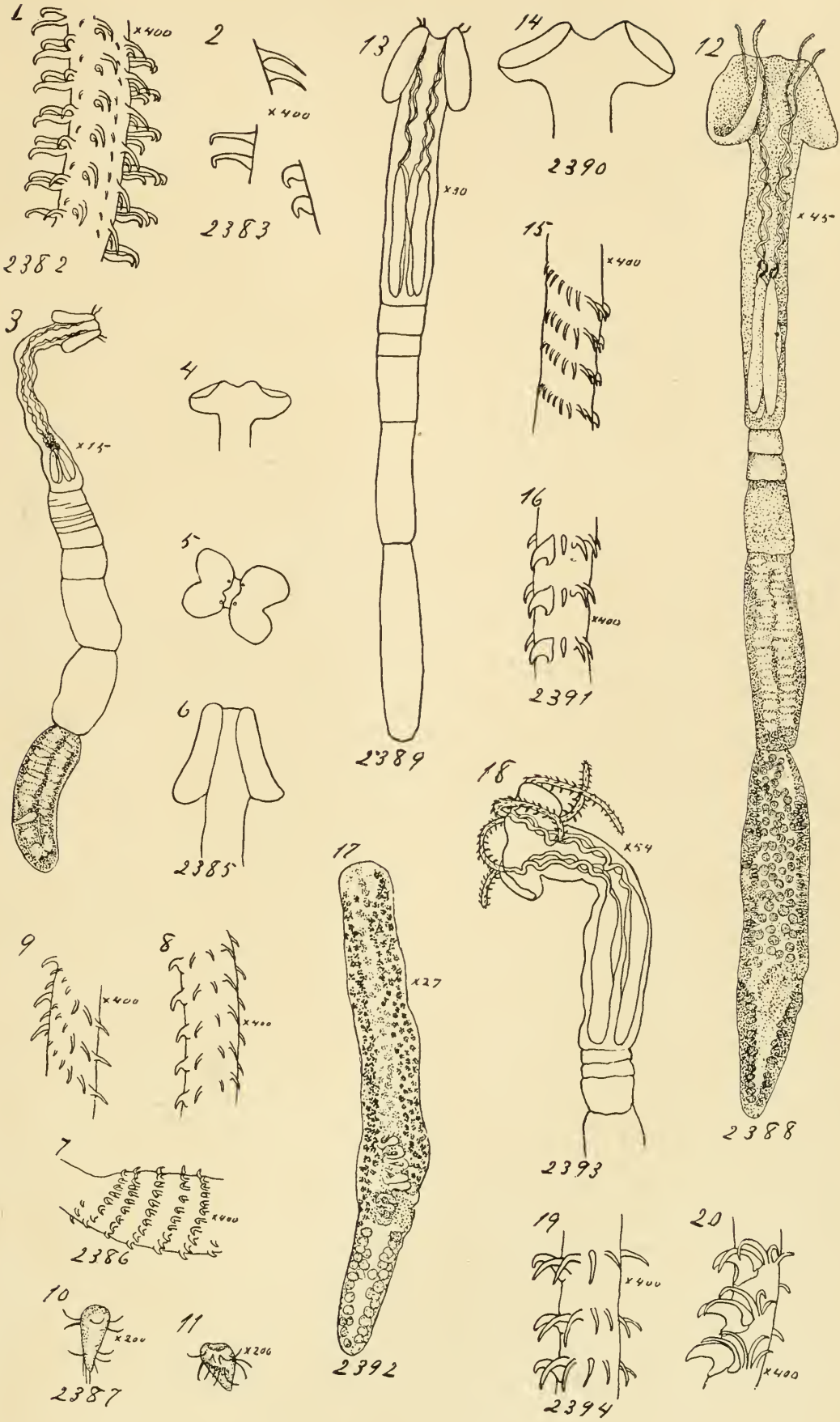
Rhynchobothrium hispidum, sp. nov.

FIG. 12. Strobile, outline from life, some of the details supplied from alcoholic specimen, × 45.
FIG. 13. Strobile, from life, × 30.
FIG. 14. Outline of head, bothria directed forward; from life.
FIG. 15. One view of proboscis, middle, × about 400.
FIG. 16. Another view, near middle, × about 400.
FIG. 17. Mature segment, from alcoholic specimen, × 27.

Rhynchobothrium longispine, sp. nov.

FIG. 18. Head and neck, from alcoholic specimen, × 27.
FIG. 19. One view of proboscis, × about 400.
FIG. 20. Another view of proboscis, × about 400.

All the figures made by Margaret B. Linton.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x400
2382
2
x400
2383
13
x30
2389
14
2390
12
x45
2388
15
x400
16
x400
2391
3
x15
4
5
6
2385
17
x27
2392
18
x54
2393
9
x400
8
x400
7
x400
2386
10
x200
2387
11
x200
19
x400
2394
20
x400

PLATE XII.

Rhynchobothrium tenuispine, sp. nov.

FIG. 1. Proboscis, near apex, × about 900.
FIG. 2. Tumid base of proboscis, × about 900.

Rhynchobothrium heterospine, sp. nov.

FIG. 3. Head and neck, from alcoholic specimen, × 27.
FIG. 4. Principal forms of hooklets, highly magnified.
FIG. 5. Portion of proboscis, × about 400.
FIG. 6. Posterior segment, from alcoholic specimen, × 4½; *a*, hilum left by separation of this from the preceding segment; *b*, the characteristic notch forming the marginal genital aperture.

Rhynchobothrium imparispine, sp. nov.

FIG. 7. Head and neck, from alcoholic specimen, × 15.
FIG. 8. Proboscis near middle, × about 200.
FIG. 9. Proboscis near apex, × about 200.

Rhynchobothrium wageneri, sp. nov.

FIG. 10. Strobile, outline from life, details of last segment filled in from alcoholic specimen, × 18.
FIG. 11. Base of proboscis, showing the arrangement and relative sizes of the basal hooks and the single large hook. The latter lies on the outer side of the proboscis as shown in Fig. 10, × about 400.
FIG. 12. Proboscis near apex, × about 400.

All the figures made by Margaret B. Linton.

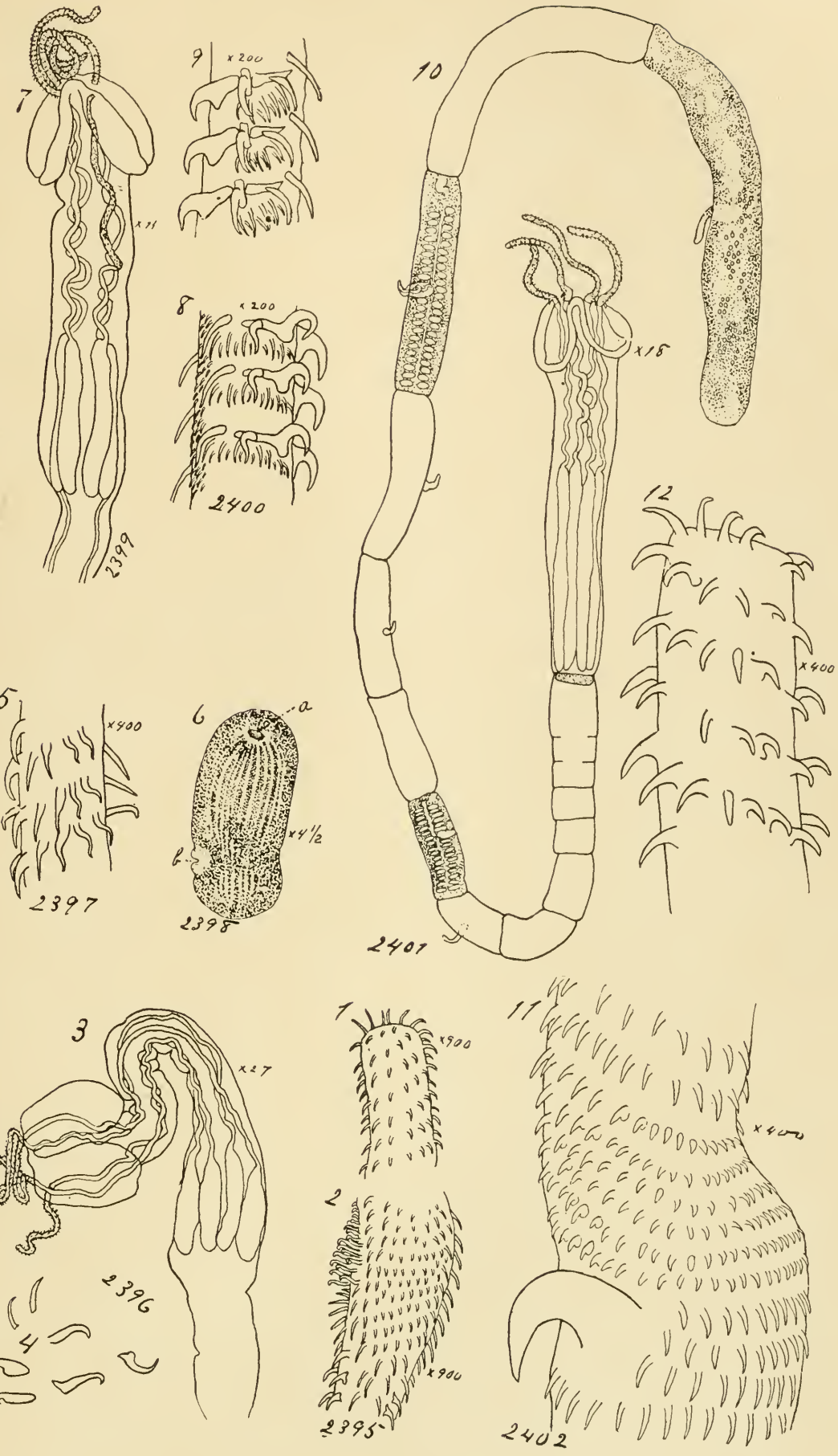

7
x11
2399
9
x200
8
x200
2400
10
x15
2401
12
x400
5
x400
2397
6
a
b
x4½
2398
3
x27
2396
1
x900
2
x900
2395
11
x400
2402

PLATE XIII.

Rhynchobothrium lomentaceum Diesing.

FIG. 1. Head and neck, from life, × 4½.
FIG. 2. Fragment of strobile, from life, × 4½.
FIG. 3. Part of proboscis, × about 200.

Rhynchobothrium longicorne, sp. nov.

FIG. 4. Head and neck, from alcoholic specimens, × 12.
FIG. 5. Posterior segments, from alcoholic specimens, × 4½.
FIG. 6. Tumid base of proboscis, × about 200.
FIG. 7. Middle of proboscis, × about 200.
FIG. 8. Proboscis near apex, × about 200.

Otobothrium crenacolle, gen. et sp. nov.

FIG. 9. Strobile, outline from life, details of last segment supplied from alcoholic specimen, × 30.
FIG. 10. Lateral view of head, from life, bothria appressed in front, × 54.
FIG. 11. Another view, from life, bothria separated in front, × 54.
FIG. 12. Otosac, retracted and forming a ciliated pit, from alcoholic specimen, × 200.
FIG. 13. Otosac, everted and forming a ciliated papilla.
FIG. 14. Proboscis near base, × about 900. The small hooklets are not always easily seen.
FIG. 15. Proboscis, usual appearance, × about 900.

All the figures made by Margaret B. Linton.

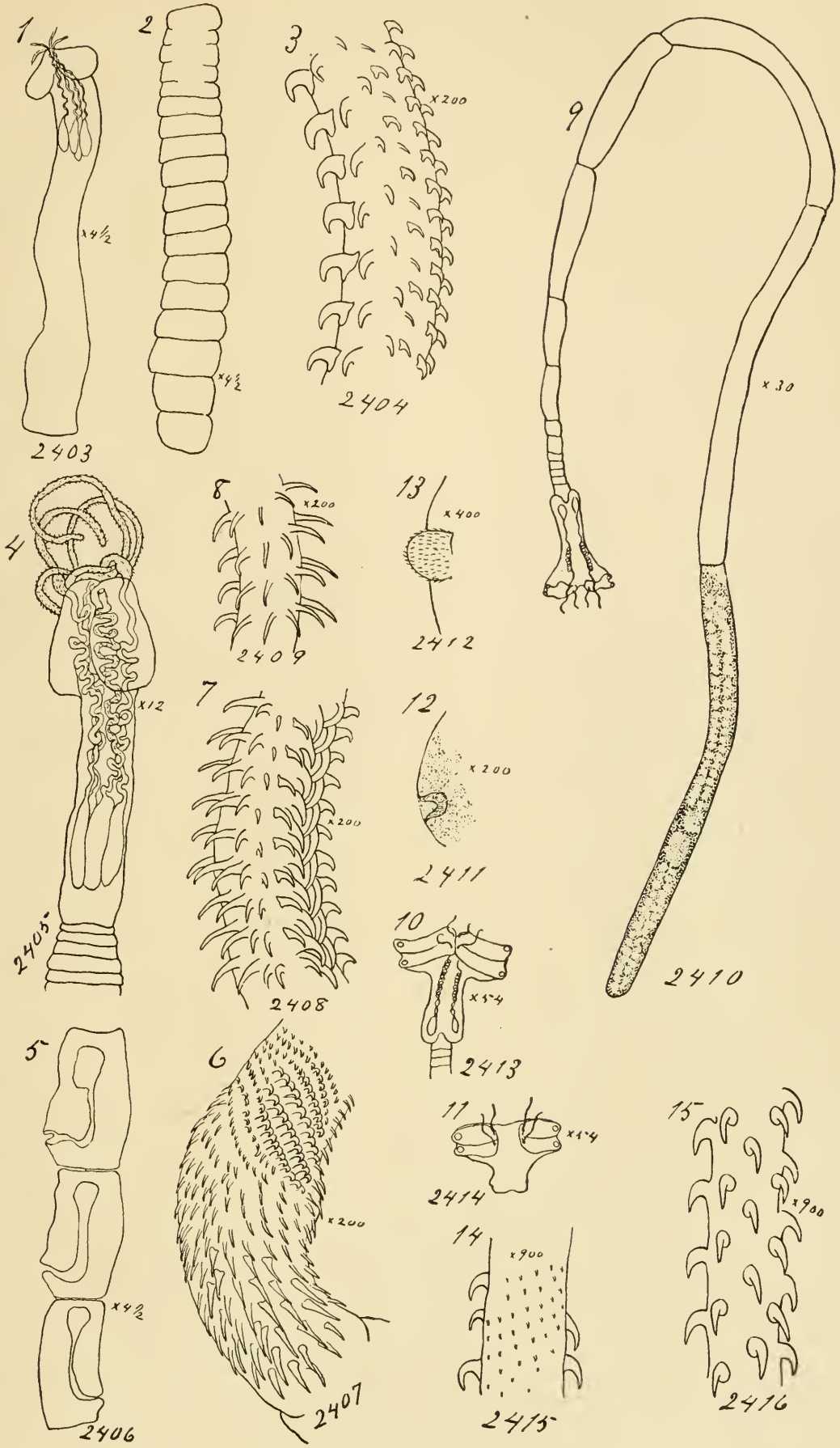

1
x4½
2403
2
x4½
3
x200
2404
9
x30
2410
4
x12
2405
8
x200
2409
13
x400
2412
7
x200
2408
12
x200
2411
10
x1·4
2413
5
x4½
2406
6
x200
2407
11
x1·4
2414
14
x900
2415
15
x900
2416

PLATE XIV.

Otobothrium crenacolle, gen. et sp. nov.

FIG. 1. Outline of strobile, from life, × 8.
FIG. 2. Outline of a more slender strobile, from life, × 10.
FIG. 3. Proglottis, from alcoholic specimen, × 18; *a*, *a*, ovaries.
FIG. 4. Proglottis, the central portion tumid on account of an aggregation of ova; the size of the latter is somewhat exaggerated in the sketch; from an alcoholic specimen, × 12.

Tetrarhynchus tenue, sp. nov.

FIG. 5. Outline of strobile, from life, × 21.
FIG. 6. Proboscis, × about 400.

Tetrarhynchus robustum, sp. nov.

FIG. 7. Head and neck, from life, × 36.
FIG. 8. Proboscis, × about 400.
FIG. 9. Posterior segments with ova, from life, × 24.

Tetrarhynchus bisulcatum Lt.

FIG. 10. Outline of section through base of bothria, × 24; *a*, *a*, sulci separating the bothria of the lateral pairs from each other; *b*, *b*, marginal spaces separating the pairs of bothria; *c*, the four contractile bulbs of the proboscides; for an enlarged sketch of one of these sections see Fig. 12.
FIG. 11. Outline of section through the tubular neck and contractile bulbs, × 24.
FIG. 12. Transverse section through a contractile bulb, × about 200: *a*, interior cavity which in life is filled with a fluid containing a few refractile granules, the function of the fluid, when compressed, being to evert the proboscis; *b*, section of retractor muscle; *c*, section of muscular wall of the bulb, showing the alternating layers of diagonal muscles.

All the figures made by Margaret B. Linton.

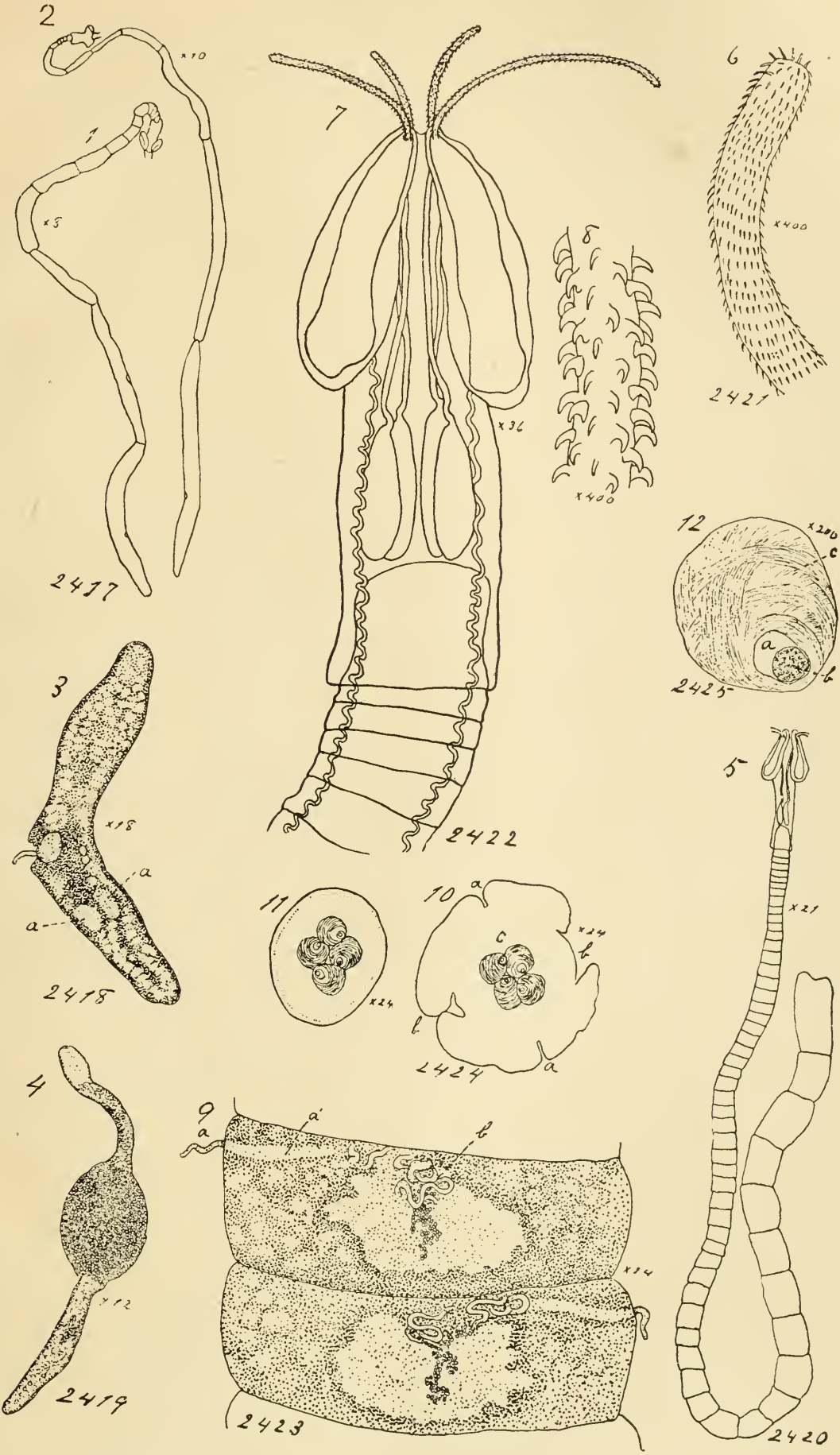

2
x10
1
x5
2417
7
x36
2422
x400
6
x400
2421
12
x200
c
a
b
2425
3
x18
a
a
2418
11
x24
10
a
c
x24
b
b
a
2424
5
x21
2420
4
x12
2419
9
a
a'
b
x14
2423

PLATE XV.

Tetrarhynchus bisulcatum Lt.

FIG. 1. Portion of pyloric division of the stomach of *Carcharias obscurus* with the parasites attached to the mucous membrane. In some cases two or more scolices are buried in a common pit, × 1½.

Syndesmobothrium filicolle, sp. nov.

FIG. 2. Sketch of alcoholic specimen, × 15. The specimen is immature and the posterior part *a* is evidently a blastocyst from which the anterior part or scolex has been everted.

FIG. 3. Hooks, the smaller ones from the base, the larger from the middle of a proboscis, × 200.

FIG. 4. View of top of head, from alcoholic specimen, × 50.

Paratænia medusia, gen. et sp. nov.

FIG. 5. Strobile; outline from living specimen; details of anatomy supplied from alcoholic specimen, × 15. The last two segments are filled with ova. The tentacular proboscides were everted after the specimen had been placed in alcohol.

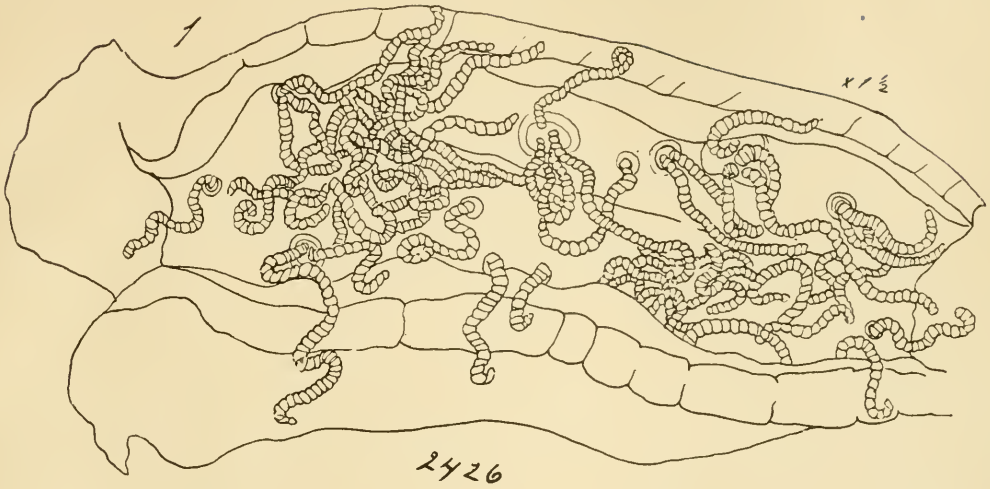
FIG. 6. Outline of strobile, from alcoholic specimen, the tentacular proboscides retracted, × 18; *a*, terminal os into which the proboscides are retracted.

FIG. 7. Outline of strobile with three of the tentacular proboscides protruding, from alcoholic specimen, × 18.

FIG. 8. Top of head, all the tentacular proboscides extended, making a terminal rosette, or sixteen-rayed crown, from alcoholic specimen, × 200.

FIG. 9. Side view of head showing tentacular proboscides and two of the bothria, from alcoholic specimen, × 200.

Figures 6, 7, 8, and 9, by the author, the others by Margaret B. Linton.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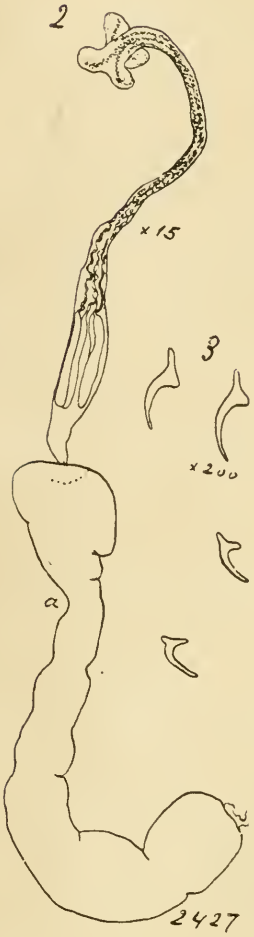
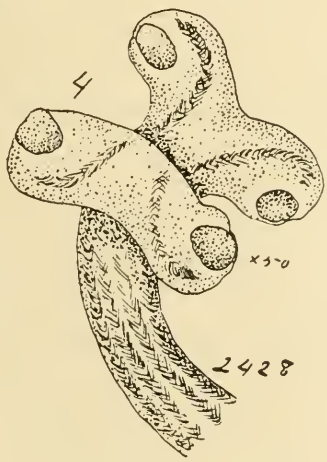
x 1½
2426


2
x 15
a
2427

3
x 200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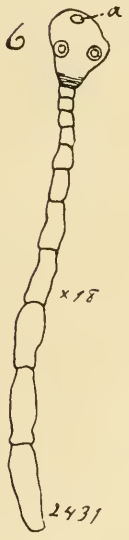
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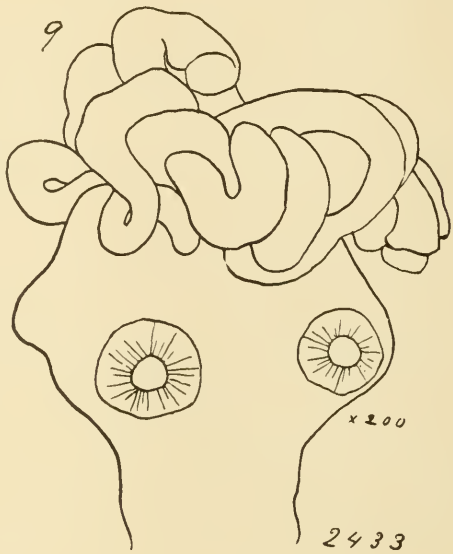
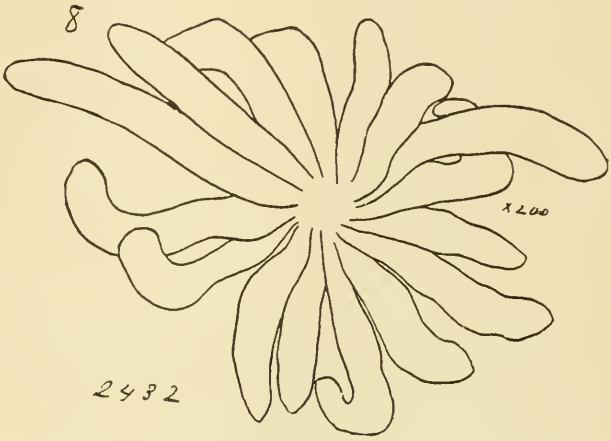
a
x 15
2431


9
x 200
2433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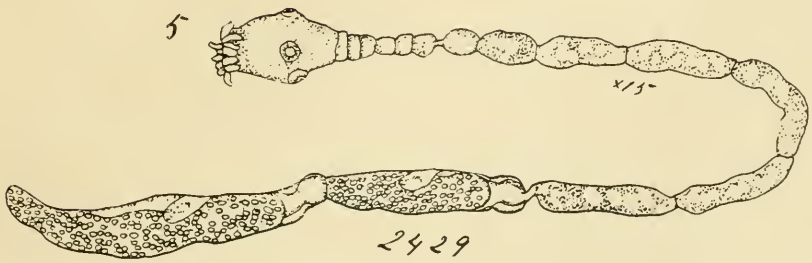
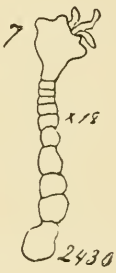
2432


5
x 15
2429


7
x 15
2430

INDEX.

[NOTE.—The references are to page-figures in brackets.]